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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS*, or *POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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NOTICE.

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NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

The semi-annual Meeting of the Association will be held at the Rockingham House, Portsmouth, N. H. on TUESDAY, August 15, 1876, at 12 o'clock, noon.

The first day and evening will be devoted principally to business. On the second day an excursion to the Isle of Shoals is proposed, with a banquet upon returning, giving members and their friends an opportunity to return home by the afternoon trains.

GEO. B. NEAL, SECRETARY.

BOSTON, July 18, 1876.

GAS WORKS AT THE NEW JERSEY ASYLUM.

The gas works connected with the New Jersey Asylum for the Insane, at Morris Plains, were started and put in operation on the 21st ult., and everything proved very satisfactory.

The works are small, and situated at some distance from the main building, but in themselves they are complete.

Their capacity is about 25,000 cubic feet per day. The retort-house, condensers, scrubbers and purifiers are all under one roof, in a substantial stone building, all arranged in regular order. The holder (46 feet diameter and 16 feet lift) is also covered in another stone building.

The retorts are set in three benches of three retorts each (12″ × 20″).

There is one Smith & Farmer zig-zag scrubber, one multitubular condenser, and a Smith & Farmer washer.

The purifiers are four in number, 5′ × 5′, with dry centre seal, and the connexions are six inches throughout. The coal is received in four large vaults, built at one end of the retort-house, and extending under the railroad track, so that the coal may be dumped directly from the cars, through openings, into the vaults below. The works were designed by and built under the direction of Mr. William Farmer, gas engineer. The work was done by contract by the following parties: stone work by Robert Johnson; benches by J. H. Whittier; iron work by Thos. Rowland; carpenter work by Meeker & Hedden. The asylum will accomodate nearly 1000 patients, and the commissioners have shown true wisdom by securing for it the best, cleanest, and safest light, viz., Gas.

TIME FOR IMPROVEMENT.

It can not be too strongly impressed upon gas makers that the time when they have the least to do is really the most valuable time that they have. We are now at the season of the year when consumption is the smallest; when the apparatus of the works is taxed to the smallest extent, and when the force is available for doing many things that can not so well be done at any other season of the year. But, before we think of it, the short days will come, and then there will be "no time" for doing that which a breakdown forces to be attended to, and which a little forethought and care would have prevented.

Progress is being made every day in the science of gas making, and it is our endeavor to lay before our readers a record thereof. We are perfectly well aware that times are dull, and the clamor for lower prices is loud and long. If one were to visit some of our larger works to-day he would be greatly impressed with the small amount of work going on. But there is a reason for it. There is a falling off of from fifteen to twenty per cent. in the make of almost every company east of the Mississippi from what it was last year. But this is not confined to the gas business by any means. Look at all other manufacturing interests and we find the same or even a worse condition of things, and here is the reason for the small consumption. But this state of things must be temporary, and, with returning vitality in other branches of trade, will come the call for increased supply of our product. Every gas maker should be prepared to assist in creating this demand, by being ready to furnish either a better article at the same price, or the same at a lower price. This can only be accomplished by close application of the principles of the science, and a careful attention to details. An apparatus that has done all the service that can reasonably be expected of it should be replaced by new, of the most approved construction. Waste should be stopped wherever it exists, and the works put, in fact, in the most perfect order possible. And we would add more than this. A very little labor *each day* will do much to make many works much more presentable than they are. There is no reason, as we have often said before, why a gas works should be a nuisance in any neighborhood. If it is, it is the fault of the man in charge. The buildings *can* be kept clean, refuse *can* be removed, and not allowed to collect at all. The yard need *not* be a perfect catch-all for all the old pipes, old iron, and old barrels that hapl

pen to be found from time to time. Judging from some works that we have seen, it would be something of an undertaking to clear away the present accumulation; but when once done, it will be very easy to keep it so. The old adage "By their works ye shall know them" can be very aptly applied, with various meanings, to gas companies, and those in charge of their works. Vegetation will flourish about a gas works, then why not encourage it. Kept clean, and adorned with a few vines and flowers, they are made much less objectionable to outsiders, and the character of those employed therein is elevated.

A GRAND EXHIBITION OF NATIONAL INDUSTRY.

The American Institute of the City of New York, will hold its 45th Exhibition this Fall, opening on the 6th day of September next, and continuing until late in November.

This Exhibition promises to be unusually interesting, inasmuch as special effort is being made this Centennial Year to have the leading industrial operations carried on upon the premises.

A *Special* award of a Gold Medal is offered for this year, to be known as the "Centennial Medal"

The American Institute is the the oldest of all societies now in existence of its kind and is not in any sense a private corporation, its earnings being devoted by its charter to the encouragement of home industries.

For blanks and all information, address, General Superintendent, American Institute, New-York City.

WASHERS AND SCRUBBERS.

We give, in another column, a paper read by Mr. Hunt, of Birmingham, before the British Association of Gas Managers, upon this subject, and we suggest a careful reading thereof. Results are given from actual working, which are better than theory, but it is a proof of the successful study that the best minds in the business have given to the subject when actual workings and theory coincide.

A Standard of Value.

[Communicated.]

The illuminating power, the commercial value of gas! How shall it be determined for the purpose of comparison, one time with another, the product of one works with that of another, or the gas produced from a given material with that of a different material? In short, how shall we speak intelligently and understandingly of the product we deal in, when we wish to convey a definite idea of its real selling value?

This is no new question but one that has at times been a source of perplexity to every one in the business. The trouble is, we have no standard, either established by law and enforced thereby, or adopted by the common consent of gas managers for the purpose of conveying a definite meaning to each other.

Seemingly, the more the subject is investigated and experimented upon, the more hopelessly involved and beriddled it becomes. When we *all* used the old London Parliamentary Standard Argand of definite dimensions and fixed number of holes of given area, we used to understand each other in speaking of the candle power of a gas. Not so now. When we adopted the fashion of using a burner for each quality of gas, which would give the best possible results for that particular gas, we made a departure which put us all adrift in our communication with each other, and "Babelized" the language of gas value, so that no man understands the exact meaning of his neighbor's words. Not long since, the writer spent the night in a city of New England, where there was a gas works whose annual sales amount to about twenty-five million. During a call upon the engineer of the works, the subject of the illuminating power of his gas was brought up, when he made the surprising statement that his gas was of *nineteen* candle power: He used only Westmoreland coal and burned it hard, and the writer had previously made a mental estimate that the gas was about *fourteen* candles, an estimate, by the way, which was afterwards confirmed by the official report of the state inspector.

On closer investigation it appeared that the photometric burner used was one having a very small interior ring, so that the amount of air admitted to consume the gas was very much reduced, hence, the deceptive result. The engineer claimed that it was no more than fair to test his gas with that burner giving the best possible result, and that his consumers were in fault if they neglected to adopt the same burner; so that they could use the gas to the best advantage and produce for themselves the same amount of light. This may be true as concerns the consumer, but the point under discussion is a different one altogether. It is not as between consumer and manufacturer in any one city, but as between manufacturers in all places, that we need a definite expression which shall mean exactly the same thing at all times and in all places.

The engineer above spoken of fell into the common error of supposing that the burner used for experimental purposes, or for a fixed and definite object, was the best burner for *all* purposes. The truth is, that a store of ordinary area can be far better lighted with good gas, consumed in a given number of flat-flame burners, than with a corresponding number of the best argands that can be produced to encourage the flattering belief that the same gas is of far greater commercial value than it really is.

The great number of experiments and suggestions constantly offered to determine the illuminating power of gas, and its consequent commercial value, afford proof of the present unsatisfactory condition of the whole subject, and the earnest desire to provide something that shall be available as a universal standard of measure. The Patent Office is prolific in numbers of burners, any one of which "will save at least 25 per cent. of a consumer's gas bill;" but this only tends to unsettle the whole matter, so far as "*fixed standard*" is concerned. The deceitfulness of "improved" burners for *photometric* tests is well shown by Prof. Bowditch in his "Analysis and Technical Valuation of Gas," by his suggestion of an improved candle which, while conforming to the rules for measuring its illuminating power during a given period, is made, by certain alterations in its structure, to give a much diminished light.

The recent improvements by Mr. Sugg go far towards removing some of the manifest sources of error in photometry, but leave the subject still in an unsatisfactory condition.

The researches of Prof. Crookes on the mechanical action of light bid fair to offer some solution of this question of light measurement, which may be satisfactory and conclusive, but it remains to be developed and put into such shape as to be used by the practical gas manager. The attention of the gas fraternity is earnestly recommended to the application of this discovery to their daily uses, for if a fixed and positive mechanical action can be used as the measure of the light-giving power of gas, there will then remain only the simple problem of determining the amount of force producing that action, which would be a *fixed standard*. But in the meantime cannot something be done to establish a standard burner for purposes of comparison? Mr. Farmer's "Candle Feet" is a capital idea and a step in the right direction. If we only had a standard burner by which to calculate the "candle feet," we would be a long way upon the road leading to better and more exact understanding of each other. Would it not be well for the American Gas Light Association to take some steps towards *unity* in this matter?

* * *

British Association of Gas Managers.

TUESDAY, JUNE 13.

Mr. C. Hunt, of Birmingham, read the following paper on

WASHERS OR SCRUBBERS.

The comparative merits of washers and scrubbers have formed the subject of frequent discussions, both at the meetings of this association and elsewhere, resulting, it is hardly too much to say, in a growing feeling of preference for the former. Whether, however, this preference is altogether well founded, or whether the two forms of apparatus may not with advantage be used conjointly, seems to be still so far an open question, that probably a few further remarks upon the subject may not prove wholly unacceptable to this meeting.

By the term washer is generally understood that form of apparatus in which contact between gas and liquid is obtained by forcing the former through a number of seals of indeterminate depth, the same process of washing being effected in a scrubber by means of a large area of a wetted surface. The retention of the name of "scrubber" is probably useful, chiefly as serving to indicate the kind of method employed, since it can hardly be said to have any significance, except where such a vessel is used solely for the retention of tarry matter.

It has been claimed for the washer that it is cheaper in its first cost and cost of working, occupies less space, and is more efficient in removing other impurities, together with ammonia. The advantage which it possesses over an ordinary coke scrubber, in its freedom from all liability to choke up, is beyond dispute.

At the outset it is to be observed that nothing is much more easy than to take out the bulk of the ammonia from foul gas, provided the latter be sufficiently condensed, in illustration of which I may refer to one or two methods in use at the present time. One of the best with which I am acquainted is that introduced some years ago by Mr. Hugh Young, when engineer to the late Birmingham and Staffordshire Gas Company, which is doubtless well known to many gentlemen here present. It consists simply of a rectangular vessel, say 24 feet in height, by 8 feet by 16 feet, water being pumped over and over until the required strength is obtained, and distributed in a series of small jets, striking with considerable force upon a dash-plate placed underneath each jet, the effect being to fill the vessel with fine spray. Originally the interior was left entirely open, but recently it has been found that by partially filling them with thin boards, their efficiency is considerably increased. At one of the works under my charge, where the maximum pro-

duction is about 2,000,000 cubic feet per diem, two of these scrubbers are found to remove all the ammonia to within about 7 per cent. of the total quantity; that is to say, taking the total as = 100, the proportion removed

By condensation. . . .	= 46·6	per cent.
By scrubbers.	= 46·6	"
Leaving to be removed .	= 6·8	"
Total	100·0	

the resultant liquor having a strength varying from four to seven ounces.

At the Windsor Street works, purification from ammonia is completely effected by means of two scrubbers, the first being 20 feet in diameter by 40 feet high, and, when erected, fitted with four shelves sloping inwards and outwards alternately, so as to break the passage of the descending liquor and ascending gas. At the present time the two top shelves are removed, and the space filled with thin boards; but the results of which I am about to speak were obtained before this alteration was made. Through this vessel the whole of the make, up to nearly 4 million cubic feet per diem, is passed on to the second or finishing scrubber, which is also 20 feet in diameter, but 60 feet high, and of the kind known as Mann's. The liquor from this, mixed with that from the hydraulic main and condenser, is pumped over the first scrubber at the rate of from 7000 to 10,000 gallons per hour. The quality and strength of the liquor made in the second scrubber being known, as also the strength of that from the hydraulic mains and condenser, I am able, from the return of liquor made for sale, to gauge the results at each successive step, and they are as follows:—

Ammonia removed by condensation	42·7	per cent.
" " 1st scrubber	43·3	"
" " 2nd scrubber	14·0	"
Total	100·0	

I am, of course, assuming the entire absence of ammonia in the outlet gas, and this is practically the case.

The higher strength of the liquor in this instance—ten ounces—probably accounts for the larger quantity of ammonia remaining to be removed by the second scrubber.

Here, then, are two examples of simple and comparatively inexpensive plant, effective for the removal of the bulk of the ammonia, and occupying very little space. In both cases there is, of course, the cost of pumping to be taken into account; but I may mention, as a small set-off, the fact that neither vessel throws the slightest back pressure, while the whole of the tar remaining in the gas after condensation is effectually removed.

So far as I am aware, washers have not hitherto been employed to any extent for the final process of removing the last traces of ammonia, although there seems to be no reason why they should not, and a few weeks ago I had an opportunity of inspecting a new form of washer designed by Mr. Saville, of Sowerby Bridge, alluded to by the president in his opening address, which has proved efficient for this purpose. Where, however, a large quantity of ammonia remains to be extracted, the graduated series of steps leading up to clean water, which is necessary for the complete success of this somewhat delicate process, can only be obtained in a washer by adding to the number of seals through which the gas has to pass, thus increasing the back pressure to a degree which may fairly be considered objectionable. On the other hand, the coke scrubber, as a finishing vessel, can hardly be too highly commended, for although the extreme height adopted in some instances has attracted a certain amount of adverse criticism, it is impossible not to admit that a very high degree of efficiency has been thereby attained. By their use, practically speaking, absolute freedom from ammonia may by ensured, while the resultant liquor can be varied at will, and, according to circumstances, from 4 or 5 ounces strength up to 30 or even 40 ounces. I may say that the one I have, after three years of constant use, during which time the coke has not required renewal, works as freely as the day on which it was first started, the back pressure, with the whole of the water passing through, rarely, if ever, exceeding one inch. This is, of course, attributable to the thorough washing which the gas undergoes previous to entering the scrubber.

The extraction of ammonia, however, although the primary, is by no means to be regarded as the only duty of a washer or scrubber, since the process is capable of being rendered very effective for the removal of other impurities, notably CO_2 and H_2S. It ought, perhaps, to be looked upon as a settled principle in gas manufacture, that no ammonia should leave the works without bearing away with it its full burden of these gases, although it is probable that, under the most favorable conditions, not more than about one-fourth of the total impurities can be removed by its means. Mr. Livesey dealt fully with this question in the course of his paper read last year at Leeds, and I have only to say that my own calculations confirm his conclusions.

The next point for consideration then is, whether the washer or scrubber best performs this secondary, although highly important duty. With respect to this part of the subject, it is to be regretted that our sources of information are somewhat limited. One consistent advocate of the washer, however, has furnished us with evidence of a very practical nature, whatever may be the opinion formed as to its conclusiveness. In his exhaustive paper on gas purification, presented two years ago, Mr. George Anderson stated the results of an examination of the liquor obtained at the various stages of his process, which consists in first washing the gas, and finally passing it through a scrubber, the latter being supplied wi h clean water, and the liquor so obtained passed back to the washer, and mixed with that from the hydraulic main. This is precisely the same plan as that adopted by myself, except as regards the apparatus employed, my open vessel taking the place of Mr. Anderson's washer.

Mr. Anderson found that whereas the liquor from the hydraulic main had a strength of only 2½ ounces, and contained 160 cubic inches of foul gas per ounce, and that made by the scrubber was of 6 ounces strength, containing 179 cubic inches per ounce, the whole of the liquor produced, after passing through the washer, was brought up to a uniform strength of 14½ ounces, and contained 346 cubic inches of foul gas per ounce; the increase attributable to the washer being about 180 cubic inches per ounce. This no doubt speaks well for the washer, as compared with the scrubber employed in this particular instance, but it is evident that the latter can hardly have been a very favorable specimen of its kind, since it seems to have shown itself but little superior in its action upon the foul gases to the process of condensation carried on in the hydraulic main.

Good, however, as the result is, it by no means equals what is capable of attainment by good washing, and falls far short of the capabilities of the scrubber in the same direction, so far as I have been able to observe their action. For instance, the liquor delivered from the Windsor Street works has been found to contain, on the average, 438·9 cubic inches of foul gas per ounce strength, and I am able from this, and from a knowledge of what are the results of the final process of scrubbing, to arrive at the fact that the open vessel alluded to as performing the office of a washer, brings up the whole of the liquor produced in the hydraulic mian and condensers to contain 427 cubic inches per ounce strength. While two samples with which I have been favored, produced by a washer, from clean water passed once through, yielded 446·1 and 453·1 cubic inches per ounce respectively.

Taking the case of the sarubbers strictly so called, Mann's removes 509·9 cubic inches per ounce strength. A scrubber, 6 feet in diameter, fitted with sloping shelves, and partially filled with large pebbles, clean water being pumped over and over, gave 526·8 cubic inches per ounce as the result of an examination of the liquor produced; while Young's comes out best of all, removing no less than 569·1 cubic inches per ounce strength.

The balance, therefore, of such evidence as I have been able to collect, is greatly in favor of a large area of wetted surface.

Appended to this paper are the details of the analyses, giving both measurement and weight of the foul gases in each case.

As to the comparative effect of scrubbing and washing upon the formation of sulphide of ammonium, and consequent removal from the gas of sulphur present in other forms than sulphuretted hydrogen, it is, perhaps, sufficient to observe that the test for efficiency in other respects must of necessity be the measure of efficiency in this, since the same conditions are requisite in each case—namely, intimate and prolonged or repeated contact between gas and liquid. As ordinarily employed, however, ammonical liquor can scarcely be said to exercise any perceptible influence in the way of reducing the sulphur compounds, which are usually driven forward by the superior affinity of CO_2 for the NH_2.

Upon the question of comparative economy, very little need, perhaps, be said. Undoubtedly the first object to be secured is efficiency, and to obtain this, at the lowest possible cost, should be the next. At present, the highest degree of efficiency in regard to the extraction of ammonia is represented by those scrubbers, which, filled either with coke or thin boards, remove it to the last trace by water passed once through. Their exclusive use, however, is to be deprecated, not only upon economical grounds, but chiefly because it deprives the manufacturer of the active assistance in the work of purification of a very large portion of the ammonia produced. To make the most of such assistance, it is obvious that the first process which gas should be made to undergo after condensation is that of thorough washing with liquor from the hydraulic mair. It is equally clear that such can be successfully conducted by the aid of very simple means, irrespective of the washer, strictly so called, and that, by means of a similar agency, nearly the whole of the ammonia can be easily and cheaply removed, in combination with a very large proportion of foul gases.

The extraction of the small residue of ammonia, which in the instance I have mentioned amounts to no more than 14 and 7 per cent. of the total quantity respectively, is by no means the easiest portion of the work to be performed, owing to the volatile nature of the substance with which we have to deal. As just pointed out, the scrubber is a most efficient a-

strument for this final process, the success of which depends upon the maintenance of a well-distributed supply of perfectly clean water over an area of contact sufficiently large to avoid the necessity of passing the water more than once through. From what is known, however, of the washer in various forms, there seems to be good reason for believing that it can be employed with excellent effect as a finishing or catch vessel, and when this is made more apparent, its superior economy will probably render its general adoption for this purpose only a question of time. In combination with methods such as those I have referred to, and as a substitute for the somewhat costly structures now in use, it is not unlikely that in the future there may be found for the washer a wide sphere of usefulness.

Analyses of Samples of Gas Liquor.

Description. Scrubber or Washer.	Strength. Oz.	Carbonic Acid per gallon. Grains.	Carbonic Acid per gallon. Cu. In.	Sulphuretted Hydrogen per Gallon. Grains.	Sulphuretted Hydrogen per Gallon. Cu. Ins.	Total Foul Gas per Gallon. Grains.	Total Foul Gas per Gallon. Cu. Ins.	Total Foul Gas per Gallon per ounce Strength. Grains.	Total Foul Gas per Gallon per ounce Strength. Cu. Ins.	Remarks.
Liquor delivered from Windsor St Works.....	10·5	1638·0	3465·0	438·2	1143·5	2076·2	4608·5	197·7	438·9	
Washer, ...	23·5	4168·78	8820.94	639·38	1665·01	4808·16	10485·95	204·6	446·1	Water passed once through.
Ditto.....	16·4	3101·88	6563·43	333·35	868·09	3435·23	7431·52	209·4	453·1	
Mann's scrubber	10·0	1806·0	3821·0	490·0	1278·7	2296·0	5099·7	229·6	509·9	
Six foot do....	8·5	1762·3	3728·96	287·79	749·45	2050·09	4478·41	241·1	526·8	Water pumped over and over.
Young's do....	4·3	848·01	1794·35	250·72	652·91	1098·73	2447·26	255·5	569·1	

Gas Analysis.

Sir: When I ventured, a few months ago, to make some inquiry, through your valuable *Journal*, in reference to station meters without cases, the subject was taken up by various correspondents, and settled entirely to my satisfaction, in a series of letters I considered remarkable for both quantity and quality.

A new difficulty has arisen here, which I am bold enough to venture once more to submit to your indulgence, in the hope that some of your more privileged correspondents, who rendered such good service in the station meter case, may be induced to state their opinions of my difficulty, and thereby shed some light on a subject on which I may possibly be found very wrong in my views.

With all respect for the wisdom and enlightenment of our Legislature, it is liable to go wrong now and then, and I humbly think it has done so in fixing the mode of finding the illuminating power of gas. My reasons for so thinking I will now state.

Whatever may happen at the time to be the prevailing temperature or the pressure of the atmosphere in the town where the gas is tested—and on the supposition that the locality of the testing-room is chosen so as to intercept the flow of gas, under circumstances to ensure that a mean average of the general supply can be secured for testing—then the actual illuminating power of the gas so ascertained should be taken as the value of what is then passing on to the consumer. This being the case, a carefully measured rate of consumption—say 5 cubic feet of gas per hour—being found to give light equal, to, say, 25 candles, this same unit of volume being passed on and accurately measured off by the consumer's meter under unaltered temperature and pressure, must yield the same results as found by the photometer. Again, supposing the test to be made in the depth of winter, and found to be equal to 25 candles, why should the candle power not be given as it is then found, instead of a calculated estimate, which applies to other atmospheric conditions sometimes realized in summer, or *vice versa?* The changes caused in the bulk of a unit of gas due to two or three inches variation in the barometer, and 50° or 60° in temperature, may amount to 10 or 15 per cent. Why, then, let me ask, should the actual and true illuminating power of the gas at the time of testing, being also the time it is being supplied to the consumer, be altered two or three candles in its declared value from what it actually is found to be? It is, no doubt, true that sometimes it may be in favor of the company supplying the gas, and sometimes against, but that is no justification of the practice. It is also reasonable and necessary for giving value to any analysis of gas or other commodity supplied to the public, that the quality to be declared should have reference to some well-known and acknowledged standard of comparison. For example, the Excise, from which an important part of the national revenue is derived, are very exact and scrupulous in testing the strength of spirits, every gallon of which yields some 10s. revenue upon the alcohol it contains. In this instance, barometric pressure happens to be of little account, but temperature is of the highest importance, and in our local distillery, the specific gravity, being the scale on which the alcohol is calculated, is carefully noted along with the temperature, which has to be referred to a standard of 60°. This being once ascertained, and certified in regard to any specimen of spirits, the consumer, who may reside in India or in Greenland. can, in either place, or at any distance of time, re examine and verify the identity of the article as sent and certified from the distillery. It is totally different with illuminating gas, which I take to remain nearly constant in its quality between the time of testing and reaching the consumer. But, like the spirit test, it must have a standard to be referred to. Such standard is amply provided already by the photometric apparatus. Where the candle and the burner employed are in conformity with the parliamentary regulation, all that remains for making it complete is that the utmost attention be given to ensure that the indicated candle power on the scale is due to the rate of gas consumption being 5 cubic feet per hour, and the candle power thus determined should be subject to no change by calculations to suit any other or imaginary atmospheric conditions not then existing.

It was well-known to a past generation of gas managers that the illuminating power of perfectly pure coal gas increased with its specific gravity, and that a knowledge of the one furnished by inference a knowledge of the other. The temperature and pressure had, of necessity, to be taken into account for ascertaining the density of the gas. Excepting for the object of following out this obsolete inferential process (which, for many reasons, was liable to serious error) there is, to my mind, no other intelligible or practical purpose attained by setting up a standard of temperature and pressure differing from what prevails and influences the gas at the moment of analysis. Farther; while it is doubtless quite true that temperature and pressure of the atmosphere have each important influences upon the combustion, and probably also upon the light emitted from gas-burners and candles, it must be remembered, in considering this question, that these influences, whatever they may be, operate precisely in the same way—to the same extent and at the same time—upon the light and the combustion of the same gas on which the analyst is experimenting, and, having their full effect, the resulting and *true* indication of illuminating power comes out distinctly visible on the photometric scale, and becomes falsified by any alteration made on such readings, whether by calculation or otherwise.

If my views on this very important element as affecting gas supply are wrong, it might be of value to others engaged in the business besides myself, that such error be clearly pointed out and put right.

A. Micawber, Jun.

—*London Journal of Gas-Lighting.*

Strength of Iron and Steel

In illustration of the effect of the repetition of strains on iron and steel, Mr. George Berkely, C. E., stated at a recent meeting of the Institution of Civil Engineers, London, that, with blows powerful enough to bend bars of cast iron through one-half of their ultimate deflection (that was to say, the deflection which corresponded to their fracture by dead pressure), no bar was able to stand 4,000 of such blows in succession. And also, that when the bar was thrown into violent tremor, then "when the depressions were equal to one-half of the ultimate deflection, the bars were broken by less than 900 depressions." A piece of rail, weighing 68 lbs. per yard, made of Bessemer metal, which, when placed on firm bearings, 3 feet apart, bore one blow from a weight of 1 ton falling through 30 feet without breaking, though bending about 7 inches, broke with a weight of 3¾ cwt. falling 15,000 times through heights increasing from 1 foot to 10 feet by increments of 6 inches each time. With wrought iron, it resulted from an experiment of Sir William Fairbairn, that when it was desired to repeat the application of strains from 2 to 3 million times, it would not be prudent that such strains should exceed 7 tons per square inch of section.

From these considerations, therefore, the practical strength of wrought iron, in structures of a permanent character, cannot be estimated at more than twelve tons per square inch, when such an amount of strain is repeated more than a small number of times, nor calculated as exceeding 7 tons per square inch when strains of this amount are to be applied to it many times daily. In some of the principal suspension bridges a maximum of about 9 tons per square inch of section in tension has been imposed on extraordinary occasions, while railroad bridges are frequently subjected to the maximum calculated strain, a limit of 5 tons being in this country generally adopted. From this practice it is assumed that a margin, for errors of design and for other practical defects, of only 25 per cent. is allowed in permanent structures. The importance of sound principles of design is, therefore, manifest. The parts most difficult to design are those of portions of the structure that are united with riveted joints. It is desirable that the area of the section of the rivets to be sheared, as well as of the plates forming these connections, should be somewhat in excess of the sectional area of the plates or bars which they connect; and that, as the process of punching the rivet-holes in the plates, etc., has a tendency to weaken them in a greater proportion than that in which the area is decreased, it is advantageous to drill all rivet-holes in parts exposed to tension. The general principles of design are well illustrated by a joint made of a single pin, such as that used in suspension bridges, Warren girders, etc.

—*Mining Journal.*

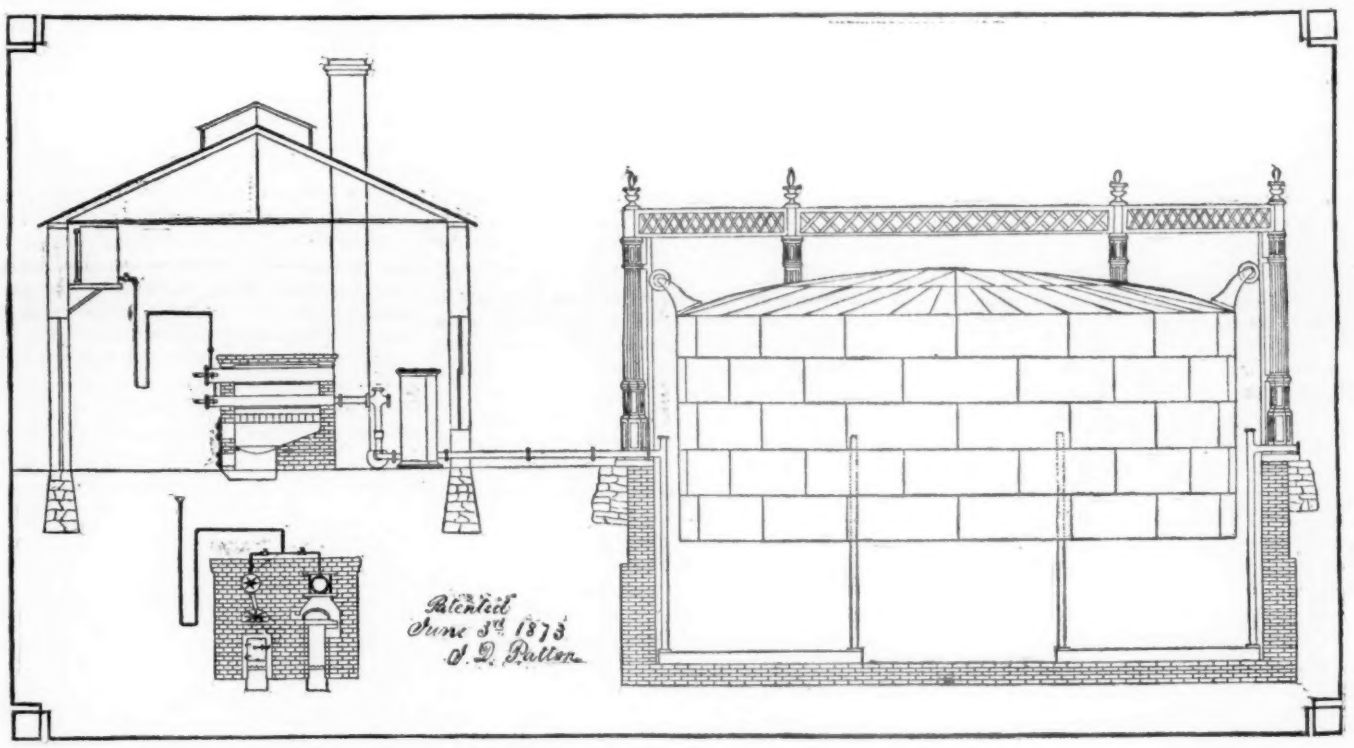
Patton's Petroleum Gas Works.

The GAS-LIGHT JOURNAL in its Report of the Proceedings of the last Annual Meeting of the American Gas-Light Association, published a paper read there "On the Use of Petroleum and its Products in the Manufacture of Illuminating Gas," by J. D. Patton, of Treverton, Pa.

That paper was devoted more especially to showing the practical value of oil gas in combination with coal gas, in existing coal gas works, and scarcely touched upon the uses of oil gas for entirely new gas works.

For towns not already provided with gas works, and for large private consumers of light, whether from gas or kerosene, these works are claimed to offer many advantages.

Herewith is presented a plan of one of Mr. Patton's works (taken from his drawings of the Mahanoy City (Pa.) Gas Company's Works), where the gas is manufactured and used in its pure state, without any admixture. The plan shows the small oil tank containing the daily supply of oil, the retorts, the hydraulic main, and the scrubberr in the building, and the condensers in the bottom of the gasholder tank. This is the entire works, and it is claimed that a simpler or more economical "plant" for gas-making can scarcely be devised.



These works have been especially constructed to, and Mr. P. claims they do overcome, all the difficulties heretofore met with in the manufacture of petroleum gas, and that they will produce the best results in absolutely fixed gas yet atatined from petroleum, with the least amount ot labor, fuel, and repairs, and with any or all forms of petroleum, while the single retort or continuous heat systems, whether the retorts be in the form of cylinders, pots, or compartmented chambers is practically confined to some special form of petroleum and to very imperfect results.

As a special inducement to large private consumers of light, Mr. Patton offers to build works for them, entirely at his own expense, where the amount of gas used will reach $300 per month, and supply the parties with gas by contract, at very reduced rates.

Private consumers of gas, in quantities less than $300 per month, can have the works built for them, and guaranteed to be satisfactory, *with ample time to test the works before paying for them.*

Established gas companies who desire the works for enriching coal gas, can have the plans furnished, and *exclusive* right to use the works within their territory, for a royalty based on amount of annual saving resulting from the use of the works.

Mr. Patton clrims that the success of these works is now fully established by numerous gas companies and other consumers, who have been using them for the past two or three years with real success.

Parties desiring further information can obtain it by addressing J. D. PATTON at Treverton, Northumberland County, Pa. stating purpose for and locality at which they will probably want gas works.

The Analysis of Mineral Coal (Anthracite, Bituminous Coal, Lignite, etc.) for Practical Purposes.

By Prof. G. C. WITTSTEIN.

[*Translated for American Chemist, by Carl Burns.*]

Having been for many years extensively engaged in the examination of mineral fuels of all kinds, I may perhaps be justified in believing that the continued practice and experience in this branch of analysis has secured for me some considerable skill, leading me at the same time to methods possessing some advantages over many now in use. With these hopes the following article was published·

The question whether a given specimen belongs to the class of pit coals or to the class of lignites, has only on rare occasions been put to me; as practical men are either well-informed on this subject previously, or consider the question of but little importance. It may be well, however, in the present article to give this point some attention, mentioning at least several methods by which the question can be satisfactorily answered. About as much of the pulverized specimen as can be held on the end of a spatula is to be heated with about 5 gms caustic potash (sp. gr. 1·12), for several minutes, and then allowed to cool. If, after cooling, the potash has remained colorless or become slightly yellowish, the specimen under examination belongs to the class of pit coals. Should the alkali however have become dark brown or opaque, the coal examined is a lignite. This process, though quite old, has never been surpassed by any of the more recent, and is especially superior to the method of subjecting coal to dry distillation, and examining the watery portion of the distillate for acetic acid. The latter process depends upon the fact that the distillate of brown coals contains considerable acetic acid, while that of pit coals is entirely destitute of it. A still more unsatisfactory method is that according to which a distinction can be made between lignites and pit coals by the quantity of sulphur they contain. It is indeed true that in general lignites contain more sulphur than pit coals; yet it is practically impossible to fix any limit sufficiently accurate to serve as a distinction between the two.

The total analysis of coal may be divided into four principal operations, for each of which a separate quantity of the sample is to be weighed out. These operations are:

I. Determination of S.

II. Determination of H_2O and the constituents of the ash.

III. Determination of C and H.

IV. Determination of N.

It is of course necessary to make a quantitative analysis of the coal in the condition in which it was delivered. It is therefore advisable, since powdered coal on exposure to air always loses appreciably in weight, to pulverize the sample as soon as received, and then immediately to weigh out for each of the operations just mentioned the following quantities:

For I.— 1 gm.	For III.—5 gms.
For II.—10 gms.	For IV.—1 gm.

I. Determination of S.

This may be conveniently carried on in a crucible of silver or platinum, which must, however, be sufficiently large to hold at least 30 gms. of water. The one gm. of the sample, previously well pulverized, is to be mixed with 4 gms. of nitrate of potash, and two gms. anhyd. sodic carbonate, in a glazed porcelain mortar. (The latter flux is simply added to diminish the violence of the reaction.) This mixture is then to be transferred in small quantities at a time to the crucible, the bottom of which has been previously heated to low redness. After each addition the lid of the crucible must be immediately put on. A gentle deflagration ensues, which must, however, have completely subsided before a fresh quantity is added. After the whole of the mixture has been introduced, the particles, which during the operation have been hurled against the sides and lid of the crucible, should be carefully scraped down into the interior. The lid is then to be replaced, and the crucible heated for at least one-fourth of an hour to a lively redness. Hereupon the flame is to be withdrawn and the crucible inclined and turned in such a manner

that the fused mass may principally distribute itself on the sides. This is done to facilitate the subsequent solution.

The mass after fusion is usually yellowish, sometimes green or greenish, from the presence of manganese. As the latter constituent is estimated with iron in II., no further account need be taken of it here.

The contents of the crucible are next to be treated with water, and the more or less turbid solution supersaturated with HCl. After this it will have become much clearer, and at times perfectly so. To this solution, filtered if necessary, $BaCl_2$ is to be added, and the S estimated from the quantity of baric sulphate precipitated. In the lignites which I have examined, the S has in some specimens amounted to as high as 7 per cent.; whereas in pitcoals I have found as little as one-fifth per cent. Coals absolutely free from S, I have never as yet met with.

In precipitating the sulphuric acid obtained by the action of sodic nitrate of the coal, there is, however, one source of error, which if not carefully guarded against, may possibly give high results. As the liquid will still contain considerable nitric acid, it frequently happens, especially if great excess of baric chloride has been added, that baric nitrate is formed. This salt, it is known, will sometimes adhere to the baric sulphate so powerfully that it cannot be washed out with water alone. When such a precipitation has taken place, the baric sulphate will on ignition evolve nitrous fumes, and will, after cooling, give with test-papers an essentially basic reaction. To free the precipitate from this impurity, it should be digested with HCl, whereby the free baryta, formed during ignition, together with the nitrate which may still be present, will be converted into chloride, in which form it may be easily washed out.

One objection may perhaps be raised against the above method of determining total *S*: namely, that it obviously will include the sulphuric acid which may have pre-existed in the coal. For the purpose of satisfying myself on this point I have made numerous experiments on fossil fuels, by treating them, in the state of very fine powder, with warm water, and adding $BaCl_2$ to the filtrate. I indeed obtained, after a time, a turbidity; the precipitate, however, in almost all cases, was so slight as scarcely to admit of further determination. All the sulphates could not, of course, have been extracted in this manner, as the dense texture of coal will prohibit water from completely saturating it, even when in the finest powder. The omission of this determination is, however, without importance in the estimation of the quality of coal. For all pre-existing sulphuric acid will remain in the ash, and will therefore be, I may say, passive or indestructive. This quantity, after being deducted from the total *S*, gives the quantity of active or destructive S present. It is the latter part of the total sulphur, which, being evolved as SO_2, gives rise to all the objectionable consequences which attend the escape of the gas (corrosion of metals, bleaching, etc).

II. *Determination of Water and the Constituents of the Ash.*

The 10 gms. of pulverized coal weighed out for this part of the analysis, are introduced into a Pt.-crucible, capable of holding at least 30 gms. of water. This crucible is then to be placed in an air bath and heated to about 120°C. It would have been possible to expel all water even at 100°C. The time, however, required in the latter case would be so much greater, that it is always advisable to elevate the temperature, as much as possible, without, however, allowing it to become sufficiently intense to decompose the coal. In any case, at least one and a half to two hours should be allowed for the complete expulsion of all water. The end of the operation may be determined by holding a plate of glass over the open tubulure of the air-bath. When a film of moisture is no longer formed, all the water has been expelled. The tubulure must then be closed, the gas turned off, and the crucible weighed immediately on cooling. The loss is water.

The quantity of water contained in some coals is truly astonishing; and yet in none of the specimens would we be likely to expect it from external appearances. Even after pulverization the coal remains perfectly dry. This peculiar fact immediately brings to our mind certain salts containing much water of crystallization, and we are strongly tempted to conclude, that the water in coal does not merely adhere mechanically, but is chemically bound, however weak this union may be. It is true that I have never as yet met with such high percentages of water in coals as are contained, for instance, in alum (45½), borax (47), Glauber salts (56), phosphate of soda (60), soda (63). Nevertheless, 20 per cent. was not unfrequent. Specimens with 30 or even 35 per cent. sometimes occur; at other times, on the contrary, I have found as little as 2 per cent.

The sample from which water has been expelled, is next to be ignited for the purpose of determining the ash. If it is desirable to determine, at the same time, whether a given specimen belongs to the class of caking, cinder, or sand coals, the lid should be kept on the crucible until the escape of volatile matter is no longer apparent. At this point the flame is to be withdrawn and the contents of the crucible examined. The residue will have the appearance of a dense, porous, apparently molten mass (caking coal), or will be but slightly coherent (cinder coal), or finally will remain in the state of a powder (sand coal).

For the purpose of hastening the progress of ignition it is well to give the crucible and inclined position, and to stir the contents carefully from time to time with a platinum wire. The operation will be complete when the combustion within the mass has entirely ceased. The residue, when cold, is to be weighed as ash.

The quantity of ash in coals varies as widely as the moisture. I have found as high as 30 per cent. and as low as 1½ per cent. As the ash always contains iron, it is never quite white; and, according to the quantity of this metal present, the ash will vary from a light buff to a dark brick-red.

The ash thus obtained is to be introduced into a small flask and digested with HCl. (1·12 sp. gr,) for one or two hours. It is then to be filtered from the undissolved SiO_2 and the sulphuric acid contained in the filtrate precipitated with $BaCl_2$. The S herefrom determined is that which I have above called "indestructive"; by deducting it from the total S previously obtained, the quantity of "destructive" sulphur may be found.

To the filtrate from the $BaSO_4$, sulphuric acid is to be added to precipitate the $BaCl_2$ employed. The filtrate herefrom should be tested with H_2S, for the purpose of determining whetner copper (which I have found on several occasions) is present. When this is the case, it may be precipitated completely with H_2S, which precipitate, after ignition, is weighed as cuprous sulphide, and the copper calculated therefrom. Copper when found in coals always exists as sulphuret.

Should the process for the separation of copper have been necessary, the iron in the liquid will have been reduced to a ferrous salt. It is therefore necessary to oxidize the liquid by ebullition with nitric acid, after which the ferric oxide, alumina, manganese and phosphoric acid may be precipitated by ammonia.

From this precipitate, previously well-washed, alumina and phosphoric acid may be separated by digestion with KHO. If to the alkaline filtrate acetic acid be then added, the phosphoric acid (necessarily present only in traces) will be precipitated as phosphate of alumina ($Al_2P_2O_8$); and from the menstruum we may obtain the remainder of the alumina by precipitation with ammonia.

The residue insoluble in KHO will consist of ferric oxide, and at times small traces of manganese. (The presence or absence of the latter metal will have been previously indicated during the fusion with KNO_3.) As, however, the determination of manganese is a matter of no importance and since the two metals, manganese and iron, have very nearly the same combining weights, we may without sensible error estimate the whole as ferric oxide. Iron exists in coals principally in the state of pyrites. It may therefore be better to report it as Fe, and not as Fe_2O_3. Coals usually contain more S than would be necessary to combine with the iron present. There are, however, some specimens in which the iron is in excess, in which case the difference will most probably exist as oxide.

In the filtrate from the iron, lime may be precipitated by oxalic acid, and thereafter the magnesia with phosphate of soda, and the quantities present estimated as usual.

I have frequently tested for alkalies, but with such unsatisfactory results that I now neglect the matter entirely. The estimation is made somewhat inconvenient from the invariable presence of magnesia. It would for instance be necessary to expel ammonia salts in the filtrate from calcic oxalate by ignition; then to precipitate the magnesia together with the H_2SO_4 present (due to the excess previously used in precipitating baryta, after the sulphuric acid estimation) with baryta water, and finally, after having precipitated the excess of baryta used, with ammoniac carbonate, evaporated the filtrate to dryness and ignited, to look for alkalies in tee residue. As such a process might give a positive result, it is perhaps better, in order to avoid as many sources of loss as possible, to weigh the residue of sulphate of magnesia and perhaps sulphates of potash and soda, freed from ammonia salts by ignition, determine the quantity of magnesia and sulphuric acid present, and then to estimate the alkalies by difference.

III. *Estimation of C and H.*

The 5 gms. of coal for the determination, after having been completely dried at 120° C. and again weighed, are to be ignited with CuO, finally in a current of oxygen, or with chromate of lead, as in ordinary organic analysis, and the C and H estimated from the CO_2 and H_2O obtained. It is fully as efficient and far more convenient to generate oxygen from potassic chlorate, instead of using a gasometer. This salt, in pieces about the size of peas, is to be placed in the back part of the tube, separated from the CuO by a layer of asbestos, and heated when the ignition has been nearly completed.

IV. *Estimation of N.*

As no specimen of coal is free from N, and since up to the present time we have no direct method of estimating O, the necessity of estimating all the other constituents of coal, including N for the purpose of making our analysis complete, becomes at once apparent. The estimation of N may be best affected by igniting the 1 gm. of pulv. coal (from which the water need not be previously expelled) with soda-lime. The N thus evolved in combination with H as ammonia, may be absorbed by acids. It was at first customary to employ HCl, convert the sal-ammoniac thus obtained into platino-chloride of ammonium, determine the quality of Pt. contained by ignition, and estimate the N from this result. Afterwards dilute H_2SO_4, was recommended. The quantity of H_2SO_4 left free after the gas had passed through was determined by a standardized solution of NaHO, whence the quantity of ammonia absorbed, and consequently the quantity of N in the coal, was calculated. Notwithstanding the fact that the latter method has been much praised, I cannot recommend it in the present analysis as in the case of a minimum of ammonia, the quantity of free acid remaining is so great as to prevent the volumetric estimation from being sufficiently accurate. Let us, for instance, suppose that the specimen contains one per cent. N (more will seldom be found, two per cent. would be beyond the maximum). In this case the 1 gm. operated upon will contain .010 g. N, corresponding to .012 of ammonia; these 12 m. g. would saturate 28 m. g. sulphuric anhydride. Now since the quantity of acid proposed seldom contains more than 1 gm. of SO_3, only the one-thirty-sixth part of it would be neutralized by the ammonia. The remainder (thirty-five

thirty-sixths) is to be saturated by NaHO, so that even a few drops would cause appreciable error in the estimation. For this reason I have continued to use HCl as the absorbent, without, however, converting the sal ammoniac obtained into platino-chloride of ammonium. The method consists in evaporating the acid gradually (finally in a watch glass) at a temperature not exceeding 100° C.

Herewith the actual analysis of coal would be completed. The only determination further desirable might be the quantity of thermal units evolved by the ignition of the specimen. By a thermal unit I here mean, the quantity of heat necessary to raise one kg. of water 1° C.

1 gm. carbon, on ignition evolves 8080 therm units.
1 gm. hydrogen.....34464 " "

The thermal units desired may be obtained:

1. By making the percentage of 8080, which expresses the quantity of C present.

2. By taking the percentage of 34462, which expresses the quantity of free H present, and adding the results, as for example:

In a specimen analyzed were found:

51.70 — C)
3.49 — H
10.32 — O)

The 10.32 of O require 1.29 H, for the formation of H_2O; there therefore remain:

51.70 — C)
2.20 — H)

Hence,

1. .5170 × 8080 = 4177.3600
2. .0220 × 34462 = 758.1140

Sum = 4935.5240

which expresses the number of thermal units produced by ignition of 1 gm. of specimen.—*American Chemist.*

Newcastle-upon-Tyne Chemical Society.

General Meeting, March 23, 1876.

John Patterson, President, in the chair.

THE EXPLOSION IN GREY STREET.

Mr. Freire-Marreco—As a good many versions of the accident in Grey street have been circulated, some of them exceedingly wild ones, and as in some respects the explosion itself was rather interesting, I thought it might, perhaps, not be altogether amiss that we should have some short account of it recorded in our "Transactions." Without going into detail as to all the evidence that has been collected on the subject, I need not remind anybody that there was an explosion in Grey street, close to the Bank of England, and a tolerably severe one.

With regard to the explosion itself, the only point of special interest was the direction the sound-wave took, which was very well marked, A certain amount of damage was done on the ground floor of the Bank; the sound-wave seemed to have crossed the street, and to have damaged the first-floor windows on the opposite side. It was then reflected very clearly and distinctly, so as entirely to miss the *first-floor* windows of the Bank, and scarcely to leave a single window unbroken in the top storey. That is all the interest attaching to the explosion itself. As to the cause, it seems perfectly clear that on the morning of the explosion a gas bag—which was supposed by the sender to be an oxygen bag, but which in reality was that which had been used to contain coal gas for the lime light—was sent to be filled, and was returned with a message that it was the wrong bag. The sender had in the meentime, probably supposing he had still got hold of the hydrogen bag, put coal gas into the real oxygen bag. We can hardly say very accurately what quantity he put in; but I should say, putting the different accounts together, the probabilities are that he had somewhere about two cubic feet of explosive mixture in the bag. Of course, whether it was mixed at all accurately in the proportions necessary for explosion, we can only speculate. The accounts of the principal actors in the filling of the bag are very discrepant; in point of fact, they contradict each other flatly in one or two respects; but on the balance of evidence, these are the conclusions one can hardly help coming to.* Now we have this boy started with the bag—and it seems to have been rather a leaky one—down Grey street; and, as we all know, he had got as far as Messr's Reid's shop when the explosion occurred. I was at first inclined to think that the boy, being possibly an amateur chemist, and knowing there was gas in the bag, had been experimenting with a lucifer match on his own account, the more so as the police found lucifer matches in his pocket. But one witness, who picked him up immediately after the explosion, says he watched him for some little distance down the street, and is quite certain that he did not touch the bag in any way except carrying it, and did not light it, and did not seem playing any tricks with it. Then the difficulty arises—how did it go off? Because, of course, the suggestion as to concussion by its falling on the pavement—the boy says he dropped it on the pavement to rest himself, being tired—is a perfectly absurd one; and so are one or two others which have been suggested. But, luckily, we have another witness, who says he saw a man come up just behind the boy with his pipe lighted, and throw away the match with which he had apparently just lighted it. This witness says he saw the match fall, still red, towards the bag, and the explosion immediately followed. So that, after all, it was no very extraordinary circumstance chemically which brought about the explosion. But the point of interest seems to be the rather long train of coincidences which was required. First, you get a man who does not know much about the management of lime lights to make an explosive mixture in a gas-bag; then, that gas-bag has to be a leaky one; then the leaky bag has to be placed on the pavement; and last, not least, some one has to light his pipe and throw away the match. The evidence seems to show very clearly that all this did occur, and I think the conclusion to be drawn from it is that it is very unlikely the same train of circumstances will ever come together again—at least in Grey street. The violence of the explosion can be judged of from the specimens on the table; these are the only two pieces of the bag which we have been able to get hold of, and this little piece, I believe, was projected through one of the top windows of the Bank, so that the explosion must have been a pretty violent one. There arises naturally the question of how far the accident could have been prevented. I don't know that it could have been prevented as long as you have gentlemen dealing with lime-lights, one of whom says his usual practice is, "I first turn on my jet of oxygen and light it; when that has warmed the lime sufficiently, I turn on the common gas. I use my own judgment;" and how far his own judgment is to be relied upon I think we can all of us see. Then we have the other manipulator of the gas bag, who says he filled it partly with coal gas; "that I sent down to the dealer: I thought he would put the oxygen into it and mix it. I am not acquainted with the management of experimental gases;" and I think we shall all endorse his desrription of himself. These are all the points of interest in the explosion, but I thought it as well that we should have some short account of it in our "Transactions."

The President said he was sure they would all join in thanking Mr. Freire-Marreco for his interesting account of this explosion.

Mr. Glover thought the society ought to bear its testimony to the fact that the authorities of the town should have some control over the retailing of such a dangerous mixture as that of oxygen and hydrogen.

Mr. Joseph Swan—I think it ought in fairness to be said that such a mixture of gas was probably never in Grey street before, and that the likelihood of its being in Grey street again is extremely remote. It is entirely unusual to make a mixture of oxygen and hydrogen. Formerly, as every chemist in this room knows, it was a common practice to make a mixture of hydrogen and oxygen, and burn the two gases from one jet; but it is long since that practice was abandoned, and now the regular course is either to use two bags—one containing coal gas and the other oxygen—or to use only one bag, oxygen, the other gas being taken direct from the main; and this latter is the general practice.

* I am indebted to Capt. Nicholls for an opportunity of examining the evidence taken by the police authority.

Health and Sewage of Towns.

Report on the Results of the Recent Conference at the Society of Arts.

The following report has just been issued:—

The Chairman of the Conference and the Executive Committee, after having carefully considered the information furnished from the various localities, as well as the facts brought forward during the conference, have to submit the following as the conclusions to which such information appears to lead:—

1. In certain localities, where land at a reasonable price can be procured, with favorable natural gradients, with soil of a suitable quality, and in sufficient quantity, a sewage farm, if properly conducted, is apparently the best method of disposing of water-carried sewage. It is essential, however, to bear in mind that a profit should not be looked for by the locality establishing the sewage farm, and only a moderate one by the farmer.

2. With regard to the various processes based upon subsidence, precipitation, or filtration, it is evident that by some of them a sufficiently purified effluent can be produced for discharge, without injurious result, into water-courses and rivers of sufficient magnitude for its considerable dilution: and that for many towns, where land is not readily obtained at a moderate price, those particular processes afford the most suitable means of disposing of water-carried sewage. It appears, further, that the sludge in a manurial point of view is of low and uncertain commercial value; that the cost of its conversion into a valuable manure will preclude the attainment of any adequate return on the outlay and working expenses connected therewith; and that means must, therefore, be used for getting rid of it without reference to possible profit.

3. In towns where a water-carried system is employed, a rapid flow, thorough ventilation, a proper connection of the house drains and pipes with the sewers, and their arrangement and maintenance in an efficient condition, are absolutely essential as regards health; hitherto, sufficient precautions have rarely been taken for efficiently ensuring all the foregoing conditions.

4. With regard to the various dry systems, where collection at short intervals is properly carried out, the result appears to be satisfactory, but no really profitable application of any one of them appears as yet to have been accomplished

5. The old midden or privy system, in populous districts, should be discontinued, and prohibited by law.

6. Sufficient information was not brought forward at the conference to enable the committee to express an opinion in regard to any of the foreign systems.

7. It was conclusively shown that no one system for disposing of sewage could be adopted for universal use; that different localities require different methods, to suit their special peculiarities, and also that, as a rule, no profit can be derived at present from sewage utilization.

8. For health's sake, without consideration of commercial profit, sewage and excreta must be got rid of at any cost.

The Executive Committee, whilst abstaining from submitting any extensive measures, have no hesitation in recommending that the prevention of dangerous effects from sewage gases should receive the immediate attention of the Legislature, and they submit the following resolutions as the basis of petitions to Parliament:

1. That the protection of public health from typhoid and other diseases, demands that an amending Act of Parliament be passed, as soon as possible, to

secure that all house drains connected with public sewers in the Metropolis, and towns having an urban authority, should be placed under the inspection and control of local sanitary authorities, who shall be bound to see to the effective construction and due maintenance of all such house drains, pipes, and connections. Provisions having this object in view already exist in the Act constituting the Commissioners of Sewers in the City of London, in the Metropolis Local Management Act, 1855, and in the Public Health Act, 1875, but practically they seem scarcely sufficient for the purpose.

2. That plans of such drains and connections be deposited in the charge of the respective local authorities, who shall be bound to exhibit them and supply copies of them to the public on payment of a moderate fee.

3. That the owners of houses be compelled by law to send to the respective local authorities, within a specified time after the passing of the Act, plans of all house drains on an appointed scale. Signed by

THE RIGHT HON. JAMES STANSFELD, M. P., Chairman of the Conference.

Members of the Executive Committee.
- Lord ALFRED L. CHICHELL, Chairman of the Council.
- F. A. ABEL, President of the Chemical Society.
- Sir HENRY COLE. K.C.B.
- Capt. DOUGLAS GALTON, R E., C.B., F.R.S.
- Lieut. Col, E. F, DU CANE, R.E., C.B., Surveyor-General of Prisons.

Health and Atmospheric Pressure.

The extended operations of mining and tunnelling, and the many submarine works now prosecuted, which greatly multiply the occasions when it is neaessary to labor amidst compressed air, have given opportunities for the collection of data relative to the effects of abnormal barometrical pressure on human health and life. In studying this subject, Messrs. Guerard, Pol, and Watelle came to the following conclusions:

1. That labor in compressed air is much easier undergone without disadvantage during youth, viz., from the age of 18 to 26—but that during the age of from 30 to 40 years such work is very liable to induce cerebral and pulmonic congestion.

2. That a pressure equal to four atmospheres is far less detrimental than rarification in a much less proportion.

3. That a sudden return from extra pressure to a normal atmosphere is productive of evil, and therefore the change should be gradual.

4. That accidents arising from a too sudden relief of pressure are best relieved either by an immediate return of the pressure, or by the immediate application of cold.

M. Bert, a savant who has lately experimented extensively to determine the physiological modifications and the general effects of such accidents has proved that oxygen, when its proportion in the blood is too greatly augmented, acts like a poison, with phenomena of convulsions. He attributes the accidents arising among workmen in compressed air—which is renewed with such rapidity that the proper proportion of carbonic acid is not formed—to this poisonous nature of oxygen. He says; "In my view, the incontestable advantage which is shown in the use of compressed air for some diseases, and on the other part, accidents which have happened to miners, and workmen on the foundation of bridge-piers and in diving-bells, show that both effects are due to the introduction in the blood of more than the normal quantity of oxygen, and that the latter produces an effect similar to other poisons, which, in small doses, are beneficial."

In another series of experiments, the learned Professor demonstrated that when only a small quantity of oxygen was added to the blood, the chemical combinations into which the gas had entered were easily dissolved by a gradual relief of pressure. The practical result of the experiments of M. Bert is, that the influence of the changes of barometrical pressure (where actual compressed air is not in question) is due exclusively to the quantity of oxygen in the atmosphere, viz.: At too low pressure, liability to asphyxia; at too high pressure, tendency towards poisoning. But the pressure of oxygen outside, from whence arises the quantity contained in the blood, depends upon the centesimal proportion and the barometrical pressure. It is therefore easy to perceive the danger to the one of an inverse modification of the other.

Certain employments, which require that the workmen remain under a pressure of five or six atmospheres, may result fatally; and this amount of pressure is often exceeded in the pearl fishery, the use of submarine armor, etc. The difficulty can be overcome, however, if the air-pipes used be made to convey a mixture of air and nitrogen (azote), so calculated that the pressure of oxygen shall not exceed a proper quantity.

The valuable practical results from the researches of M. Bert have caused lively interest in the expected publication of his experiments on the means of preventing accidents to workmen from the sudden relief of a high barometric pressure. These accidents arise not only from failure of the working of air-supply apparatus, but by the regular and sudden return of the workmen to a normal atmosphere.—*American Exchange and Review.*

Injurious Effects of Snow on Steel Rails.

The following is an extract from some interesting observations communicated from an Austrian line of railway, the Kaiser Ferdinand northern line. A portion of this line, about eight English miles in length, between Florisdorf and Wagram, is very open, and often blocked with snow in winter time. The obstacle is generally surmounted by strewing sand over rails in front of the driving weels to increase their bite, and by putting on extra steam. This portion of the line in question has a double line of metals, formed partly of Bessemer steel rails and partly of light Martin steel rails, weighing about 30·50 kilogrammes per running metre. Now, the slidling of the wheels frequently causes heating of the tires and rails, which are suddenly cooled again by the low temperature of the air on the falling snow. This, in itself, must be injurious to the molecular construction of the metal. But, besides, the increased friction causes a great amount of abrasion of the upper surface of the rails at the spots where the stoppages have occurred. Examinations proved that these abraded portions varied in length from 2 to 9 English inches, 1-12th to $\frac{1}{4}$ inch in depth, and extended over the whole breadth of the rail. A train, in passing over the depressions so caused, necessarily experiences a certain shock, and it is reasonable to suppose that the concussion thereby communicated to the rail will be most felt when the ground beneath is frozen hard, so that the natural elasticity of the rail has no room to play. In three instances rails so worn snapped asunder suddenly at the abraded portion, although no flaw or defect in the metal could be detected. This led to the removal of all abraded rails from this section of the line, amounting to twenty-eight lengths of Martin steel rail, and ten lengths of Bessemer rails. No similar case of fracture is known to have occurred in the iron or puddled steel rails previously in use, although the amount of abrasion they underwent must have been at least as great. The inference is that the impoved rails of Bessemer and other steels, their superior strength notwithstanding, are less capabe of withstanding concussion than the older rails and consequently whenever they are used increased vigilance is requisite to prevent accidents in the winter time.—*The Ironmonger.*

The Preservation of Timber.

Buried in the earth or exposed to the air, timber rapidly deteriorates, and undergoes the species of decomposition known as dry-rot. This decomposition may be retarded by the application of a coat of paint to the timber exposed to the air, or by carbonizing the surface of that which is extended to be sunk in the ground.

During the last twenty years, several methods have been tried for making timber more durable, the principle of which consists in expelling the sap remaining in the ligneous fibres, in order to replace it by chemical solutions, such as sulphate of copper and creosote; but these processes, comparatively costly, and only partially successful, do not entirely accomplish their object. Starting from the fact that oak, chestnut, and certain American trees resists the action of air and damp better than others, and they owe this property to the tannin which they contain, a chemist proposes to tan the timber by substituting for the sulphate of copper and creosote a compound of tannic acid and iron. The object of injecting various substances into wood is to poison them, so that germs and microscopic growths may no longer live and propagate either on the surface or in the interior. Now tannin is one of the most active and certain destroyers of germs both vegetable and animal, which fact accounts for its preservative agency. Besides, it is to tannin that is due the almost indefinite preservation of leather. One peculiarity to be noticed in this process is that timber treated with this compound of tannin and iron, that is to say a composition similar to ordinary writing ink, is turned black.

The process of injecting timber with tannate of protoxide of iron is due to M. Hatzfeld; the Eastern Railway Company of France has experimented with it on some sleepers, and the telegraph department on some posts.

M. Boucherie has denied, in a note to the *Academie*, the efficacy of this process, contending that the attempts already made to preserve timber from dry rot by injecting it with iron salts have yielded only partially successful results, while sleepers treated by sulphate of copper have lasted twenty-five years and more. Reply is made to these objections by quoting—not the experiments of the laboratory or the workshop, but those made by time itself. It is not a rare circumstance to encounter in earth of a ferruginous nature the trunks of very old oaks, blackened and perfectly preserved; at Rouen, in 1830, some old oak pailing was discovered as black as ebony, and dating back to the Middle Ages. Not very long ago, too, a Norman vessel built of oak was discovered in an almost perfect state of preservation in the neighborhood of an iron mine in Norway. It is more than probable that the preservation of the oak under these circumstances is due to the tannin contained in the wood; it follows, therefore, that by introducing a substance rich in tannin into timber that does not naturally possess it, its resistance to decay is increased.—*Jour. Society of Arts.*

Poisoned Air in Dwellings.

An exchange says: "A scientific man who takes great interest in the subject of drainage, holds that two thirds of the miasmatic troubles in New York proceed from the kitchen sinks of the city houses. The sink-drain gets clogged with grease, and foul odors arise to the upper stories of the houses, and little pale children inhale them all night, until they have scarcely strength enough in the morning to put on their shoes and stockings.' For want of a better remedy, says the New York *Sun*, a common brick placed over the aperture will nearly obviate the trouble, and it should be the duty of every sensible head of a family to see that it is regularly placed there. A woman says that is a man's idea. The duty of every head of a family is to see that the sink is kept clean and free from grease, and that from the drain no foul odors can be thrown back into the house to poison its atmosphere. This is very easily done by a plentiful use of washing soda to kill the grease and keep the pipes free from it, and the occasional use of chloride of lime to sweeten the drain. The cost is but little, and the enemy is cleared out instead of being bottled up, according to the *Sun's* advice. Keep your sink clean and the pipes free from dirt, then clap on your brick if you want to."

To this we add that there is no necessity that the children, or any one else in the house, should inhale such foul air all night; let them sleep with the windows open more or less, in proportion to the strength of the wind, and thus give admission to the outside air, shutting off the inside air of the house from their bedrooms if necessary, and the health of the family will not entirely depend on a kitchen sink.

Correspondence

Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—Ed.

Treverton, Northumberland Co., Pa.,
July 19, 1776.

Mr. Editor: Referring to Mr. Farmer's deductions and argument in the Gas-Light Journal of the 16th of June, and to their adoption by Dr. Kidder, in the Journal of July 3rd, which says in brief:

"That because a ton of coal made directly into gas, as in ordinary practice, gives a less result in units of light than the same ton of coal made first into oil and then into gas, there is therefore a waste or imperfection of manufacture, corresponding to the difference in units of light between the direct manufacture and the indirect one."

I beg leave to differ with the gentlemen in this matter, and at the same time to say that formerly, and upon casual observation, I held the same belief; and am sorry to say that I several times expressed it in conversation, but detected the fallacy of the supposition before rushing into print with it.

Practically, in gas making, we have a given amount of *volatile* gas-producing matter in coal, which after being charged into the retort we must find in one of three forms. First—Gas. Second—Tar. Third—Solid carbon deposited in retorts. The latter is insignificant as compared in substance (weight) with the two former. The gas and the tar represent almost the whole volatile gas-producing-elements of the coal, and therefore any considerable saving that is to be made must come from the vapors that would otherwise be converted into tar. When we consider the proportion of tar usually produced, it is not easy to believe that even the total conversion of the tar into gas would add 52 per cent. to the yield of gas from any coal. It may be as well in these preliminary remarks to remember that with present style of gas making the yield of tar can be reduced only at the expense of a proportion of its fluidity, and that long before all of it that might be made into gas was so converted, the balance of tar remaining would be too thick and heavy to flow out of, or clear itself from the pipes and hydraulics.

Mr. Farmer's theory stands opposed by these facts of practice, *and more than that it is diametrically opposed by the "Rule of Squares" of which he claims the authorship.* In other words, the discrepancy between the amount of units of light produced from a ton of coal direct, and those produced from the oil that a ton of coal will make, is not due to the imperfection of existing coal gas processes, or to the perfection of existing oil gas process, but is due to that law of which the "Rule of Squares" *is an approximate coincidence.*

The 52 pet cent. of additional light (and that is a low estimate) obtained from the oil out of a ton of coal is a fixed and tangible fact, only so long as it remains a seventy candle gas. The moment you attempt to swell its bulk with wind or water, or anything else, to reduce it to 16 or 17 candles, all the advantage is swallowed up in the destructiveness of the dilution. The addition of 50 per cent. of any ordinary diluting element reduces 70 candle gas, not to 35 candles but to 16 or 17 candles; and this is not because of any light-destroying properties in the diluting element, but because the increase of bulk produced by it *is practically equivalent to a corresponding decrease in the size of the burner.*

For example, an ordinary four foot burner when using a gas diluted to the extent of 50 per cent., would only really use two feet of gas (and two feet of diluent also) per hour, and would thus practically become a two-foot gas burner. Under the "Rule of Squares" a two-foot burner will give only one-fourth as much light as a four-foot burner, although it consumes one-half as much gas; and the result all around is the same, whether you dilute the gas or diminish the burner. The facts and the practice agree. The one is equivalent to the other. Seventy candle gas makes a very handsome liget *from a one foot burner*; diluted to the extent of 50 per cent. (half and half) it makes an equally handsome light from a *four foot burner.* No person (as many of our readers are aware) would be more pleased than I would, to find a way to dilute oil gas without loss of light, but until that can be done I must regard Mr. Farmer's 52 per cent. of possible saving as a sum in arithmetic with an essential factor omitted.

Respectfully yours,
J. Desha Patton.

Chemical and Scientific Repertory.

Iron Sheets Thinner than Paper.—The Pearson & Knowles Coal and Iron Co., (England) has rolled iron sheets .0015 inch thick, (or about one-third the thickness of ordinary newspaper) without their sticking together.—*Polytechnic Review.*

It is impossible to know beforehand to whom a newly discovered fact in chemistry is going to be of value. That science, which of all others, is concerned with the molecular constitution of things, touches all manufacturing interests.—*American Engineer.*

In his address before the mining engineers, at Philadelphia, on the 1st of June, Mr. Isaac Lowthian Bell said that times of depression in trade, such as the world generally is now suffering from, are beneficial to science, insomuch that they enable manufacturers to pay more attention to processes, and effect economies in production, which they have neither time nor inclination to attend to in periods of great demand.—*Coal Trade Journal.*

The Kanawha Valley is a gas region, all the salt wells yielding more or less gas, and several furnaces have run altogether with gas, using no coal. Slowly, limestone incrustations formed in the gas vents, obstructing the coming of the gas, so that by and by very little gas was given from the wells. Mr. Tompkins has been reaming his old gas well, and has reopened the flow of gas, and obtains enough to run his furnace. Pipes are being laid from his well to the Dickenson furnace below, for there is enough gas wasted to run that furnace.—*Ibid.*

Powder for Producing Ozone.—In order to produce artificial ozone, Mr. Leader makes use of equal parts of peroxide of manganese, permanganate of potash, and oxalic acid. The two former may be mixed, but the latter should be kept in a separate paper till wanted for use. When this mixture is placed in contact with water, ozone is quickly generated. For a room of medium size two spoonfuls of this powder, placed on a dish and occasionally diluted with water would be sufficient. The ozone developes itself; it disinfects the surrounding air without producing cough.—*The Laboratory.*

To Destroy Household Pests.—For the destruction of indoor pests, hot alum-water is said to be unfailing as an insecticide. It will destroy red and black ants, cockroaches, spiders, bugs, and all the crawling pests which infest our houses. Two pounds of alum dissolved into three or four quarts of boiling water; let it stand on the fire till the alum disappears; apply it with a brush while nearly boiling hot, to every joint and crevice in closets, bedsteads, pantry-shelves and the like. Brush the crevices in the floor of the skirting or boards, if you suspect that they harbor vermin. If, in whitewashing a ceiling, plenty of alum is added to the lime, it will also serve to keep insects at a distance. Cockroaches will flee the paint which has been washed in alum water.—*Canadian Pharm. Jour.*

What is Bad Water?—Prof. Frankland answers, that every liquid is unwholesome or polluted, which (1) contains in suspension more than 1-1000,000ths of dry organic matter, or more than 3-100,000ths of dry mineral matter; or (2) contains in solution more than 2-100,000ths of organic carbon, or 3-100,000ths of organic nitrogen; or (3) which, when placed in a white porcelain vessel to the depth of one inch, shows under daylight a distinct color; or (4) which contains in solution more than 2-100,000ths of any metal except calcium, magnesium, potassium or sodium; or (5) which contains in suspension, solution, chemical combination, or otherwise, more than 1-200,000ths of metallic arsenic; or (6) which, after the addition of sulphuric acid, contains more than 1-100,000ths of per chlorine; or (7) which contains more than 1-100,000ths of sulphur in the state of sulphuretted hydrogen or a soluble sulphuret; (8) which has an acidity superior to that produced by adding two parts of hydrochloric acid to 1000 of distilled water; or (9) which has an alkalinity greater than that produced by adding one part of caustic soda to 1,000 of distilled water; (10) which has on its surface a film of petroleum or hydrocarbon, or contains in suspension more than 1-200,000ths of such oils.—*Poly. Review.*

Gas-Light Intelligence.

United States.

Judge Westbrook has given permission to Charles Edgar Appleby, receiver of the Union Gas-Light Co., to sell the franchises and other property of the company for the payment of its debts.

Knickerbocker Gas-Light Co.—Articles of incorporation in behalf of the above company, have been filed in the County Clerk's office. The capital stock of the new company is placed at $1,500,000. The incorporators and first directors are R. M. C. Graham, Jared E. Redfield, Tildon E. Doolittle, John Sickels, and George Howes.

A fire occurred on the 28th ultimo in the East side coal sheds of the Providence (R. I.) Gas Company, causing a loss of from $8,000 to $10,000; no insurance.

Improvement of the Passage over the Bar at the South Pass of the Mississippi.

The removal of the obstructions at the South Pass of the Mississippi, proceeding from the operations of Capt. Eades, is going on with unexpected rapidity. Already, a direct and navigable channel, from 200 to 400 feet in width, and 24 feet or more in depth, has been formed, reaching nearly two miles; and there remains less than 1000 feet yet in length to be excavated by the force of the current, where the channel is but partially formed, before the *jetty* pass will be open for the largest vessel. The action of the current, produced by the jetties on the bar, was somewhat singular. The removal of earth has occurred on the up-river side, and has at once attained the extreme depth of 24 to 30 feet, which depth has gradually advanced in a straight line outwards towards the Gulf, until there remains only a crust on the very edge of deep waters, which is now (the last of April) 16 to 17 feet deep. At a short distance outside of the bar, there is a knoll of sand, upon which there was, according to the Coast Survey Reports of 1874, but 11 feet depth of water. This knoll has now (April) been washed away, until 15 feet in depth now exist; and, after this knoll is passed, there is found great depth of water in the Gulf. With the channel once established, years, almost centuries, will be gone before the sediment deposited beyond the present obstructions, will extend itself to form another delta, and the preservation of a permanent channel will depend solely on the maintenance of the heads of the jetties. The new pass has been in constant use for entering and departing vessels for six or seven weeks, and already is more direct and accessible than any other entrance to the river, bidding fair within a month's time, to allow the largest ocean steamer to enter therein. The restoration of the commercial importance of the city of New Orleans is confidently anticipated by its inhabitants as an immediate result from Capt. Eades' undertaking.—*Journal Franklin Institute.*

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Minute Measurements—Time.

The chronograph is an instrument by means of which the exact time of any phenomenon is recorded up to an exceedingly small fraction of a second. It depends for its operation on currents of electricity. Its construction is as follows: A sheet of paper is wrapped around the surface of a cylinder, which is moved at a uniform speed by a train of wheel-work. A pencil held in position by a suitable arrangement is pressed against the surface of the paper, and at the same time is moved slowly along in the direction of the axis of the cylinder. This motion of the pencil is generally about the tenth of an inch in a second; that of the cylinder is such that it makes exactly one complete revolution in a minute. Under these circumstances the pencil will trace on the paper a spiral line. Near the pencil is placed an electro magnet, which, by pulling on the pencil, produces in the otherwise continuous spiral line a slight elevation. When in use a battery is connected with the electro-magnet, and the pendulum of the observatory clock is placed in the circuit, so that connection between the battery and the magnet is made or broken at the end of every half-second, second, or every other second, as may be desired. Where one contact per second is required, it may be obtained by placing one of the wires in connection with the penduium, and the other in a small dish of mercury placed directly under the pendulum, so that at the lowest portion of its swing a fine point attached to the end of the bob may just touch the surface of the mercury. Since, each time the battery current is switched on by the motion of the pendulum, the electro-magnet slightly displaces the pencil of the chronograph, it is clear that the lines on the paper will be divided into equal lengths by the elevations produced through the pull of the electro-magnet. The value of each of these equal parts will of course depend upon the number of times the clock opens or closes the circuit; that is, they will be half-seconds, seconds, or double seconds. When the paper is unrolled from the cylinder, it will be covered with a number of parallel lines, the length of each corresponding to exactly one minute of time—each divided, as already explained, into exactly equal parts, representing half-seconds, seconds, or double seco ds.

Suppose, now, that an astronomer, furnished with such an instrument, desires to note the exact time of the passage of a star over the meridian of his observatory. Wires connected with the battery circuit are carried to him—it may be a number of miles from the chronograph—and connected with a key similar to those used in telegraphic instruments. The key consists simply of an arrangement by means of which a break in the wire can be closed or opened at will. As generally arranged, the depression of the key closes the circuit, and instantly produces a mark on the surface of paper on the chronograph. The astronomer then, with his hand on the key, watches closely the star enter the field of his transit instrument At the precise moment it crosses the spider-lines he depresses the key, and thereby registers on the chronograph the exact moment of observation; the time required by the electricity to register the action being practically instantaneous. Between the seconds marks on one of the lines on the paper, representing minutes, an additional mark will now be found, corresponding, as already remarked, to the exact time of the passage of the star. Knowing the time of starting of the chronograph, the particular minute corresponding to the line containing the additional mark is obtained; the seconds are counted on the paper by the number of marks made by the clock up to the point on the given line where the additional mark is observed, while the fractional part of a second is readily obtained by dividing the space between any two consecutive clock marks into equal parts. The passage of the star, then, occurred at a given moment of time between two consecutive beats of an accurate pendulum. It is hardly necessary to say that the chrono graph has added very greatly to the accuracy and ease of astronomical observations. It is, of course, applicable to the measurement of the precise time of any other physical phenomenon.—*American Exchange and Review.*

An Innovation in Roof Construction.

At a meeting of the Manchester Scientific and Mechanical Society, Mr. Grierson in the chair. Mr. E. Grimes read a paper on the above subject.

The author, in the course of his paper, said, recently he had observed that designers of roofs, both architects and engineers, had departed from the old plan of fixing purlins with their upper surfaces parallel with the plane of the roof, and their sides perpendicular to the same, and, instead thereof, had placed them in a position with their sides vertical and their upper surfaces level. He was not quite sure, but he had reason to believe, that engineers first adopted this arrangement and that architects followed suit, presuming, doubtless, that any change made by engineers, who were usually supposed to possess superior mathematical knowledge, could scarcely fail to be right. In his opinion, however, this new mode of construction was incorrect; and, indeed, it would require very little consideration of the forces brought into action in constructing a purlined roof to demonstrate that the practice universally adopted from time immemorial was the mechanically correct one. His attention was attracted to the new arrangement and its results on the occasion of a visit to the Birkenhead Docks. Passing through one of the large coal sheds he observed that the purlins of the roof, which were of timber, (although the principals were of iron), and of great length, were trussed with iron rods and placed vertically. These were in many cases bent considerably by the weight of the roof coming in a horizontal direction, and one or two of them were so much bent that the middle portion of the trussing rods which had been upset and hollowed to form a seat for a large plate stud, were forced aside from their place on the stud to a considerable distance. Looking on the outside of the roof it was at once apparent that there it had sagged, as they termed it, and was a hollow plane. Since that time he had observed several roofs having vertical purlins, and presenting similar results. It appeared to him that the error had arisen from supposing that gravity was the only force necessary to be resisted, in which case, doubtless, the placing a purlin in a vertical position would be the strongest way. This, he contended, was not the fact, the force opposed to gravity coming into play and necessitating the strongest section of the purlin to be placed in a line with the resultant, and perpendicular to the plane of the roof.

The reading of the paper was followed by a discussion in which a general concurrence was expressed in the conclusions arrived at by Mr. Grimes.—*Van Nostrand's.*

Belts, Pulleys and Screws.

The following hints on belts, pulleys and screws, contain facts worth remembering. To find where to cut belt holes in floors: Measure the distance in inches from center of driving shaft to under side of floor: on the upper side make a mark over the center of shaft. Now measure the distance from center of shaft on machine to be driven to floor, making a mark on the floor immediately beneath the center; then measure the distance between the two marks. Transfer these figures to a board or paper, draw off the driving and driven pulleys, after finding their di ameters at the distance from each other and the floor line previously obtained, and draw the lines representing the belt cutting the floor line, which will show where the belt passes through the floor. The drawings can be made to a scale to reduce it to convenient dimensions, maintaining the proportions. The holes may now be marked off on the floor and cut with a certainty of being correct. In making the drawing it is best to do it full size on the floor, if room can be had, and allowance must be made for the thickness of the flooring. When a system of pulleys or blocks is operated by a single rope, the charge which can be sustained by the lower block is equal to the weight applied to the end of the rope multiplied with the number of ropes supporting the block. Thus, when the upper and lower blocks possess one pulley each, the load will be supported by a twofold rope; for two pulleys, by a fourfold rope, and, therefore, in the first case every pound on the end of the rope will support two, and in the second case, four pounds on the blocks. The pressure obtained by a screw is found by multiplying the force applied to the lever and twice its length, and with the number 3,1416, and dividing the product by the distance of the screw threads. This rule is founded on the facts, first, that a screw is nothing but a curved inclined plane, of which the circumference is the length, and the distance of the threads the height; and second, that the force is applied by a long lever outside the screw, and moves around the screw at a distance equal to the length of the lever, in a circle to which the diam eter is equal to twice the circle or radius, and the circumference equal to twice the radius multiplied by 3,1416. It is also observed here that for every total revolution of the screw it descends as much as the distance of the threads, while the force applied moves through a distance of several feet in the large circle at the end of the lever.—*Mining Journal.*

How "Hard" Water may be made "Soft."

A late number of the *Popular Science Monthly* contains an interesting article under the caption of "A Piece of Limestone," from which the following paragraph is taken, which contains a hint that may be useful to engineers, as well as to others who may desire to learn a simple process of rendering "hard" water "soft":

"But, though insoluble in pure water, carbonate of lime is slightly soluble in water which is already charged with carbonic acid; and as all rain water brings down carbonic acid from the air, it is capable of taking up carbonate of lime from the soils and rocks through which it filters; and it thus happens that all springs and rivers that rise in localities in which there is any kind of calcareous rock, become more or less charged with carbonate of lime kept in solution by an excess of carbonic acid. This is what gives the peculiar character to water, which is known as 'hardness'; and a water hard enough to curdle soap may be converted into a very 'soft' water (as

the late Prof. Clark, of Aberdeen, showed) by the simple addition of lime-water, which, by combining with the excess of carbonic acid, causes the precipitation of all the lime in solution in the form of insoluble carbonate, which gradually settles to the bottom, leaving the water clear."—

Price of Gas.

The following prices are *official*, having been furnished to the AMERICAN GAS-LIGHT JOURNAL by the officers of the various Gas Companies.

Albany (Peoples) N. Y.	$2.75	
Annapolis, Md.	3.40	
Atchison, Kansas	4.50	
Austin, Texas.	6.00	
Allegheny City, Pa.	1.80	20 p. ct. off prompt pay
Albany, N. Y.	2.75	
Ashland, Ohio	3.50	Street lamps 4½ hours 17 nights per month $15 per annum.
Augusta, Ga.	4.00	Net.
Anderson, Ind.	3.50	Crude petroleum.
Ashtabula, Ohio	2.00	Wren's process; $10 for 80 candle gas.
Auburn, N Y.	3.50	5 p c off prompt pay.
Allentown, Pa.	2.50	$18 per an street lamps Meter rent 10 cents per month.
Ashland, Pa.	10.00	70 candle gas, 10 p c off prompt pay. Patton's process.
Brooklyn, B'klyn.	2.75	
" Citizens.	2.75	
" Nassau.	2.75	
" Metropol'an	2.75	
" Peoples.	2.75	
" W'msburgh	2.75	
Brockton, Mass.	3.80	
Batavia, N: Y.	3.00	
Bridgton, N. J.	3.50	
Bangor, Me.	3.00	
Boonville, Mo.	4.50	
Brownsville, Tenn.	4.50	
Belfast, Maine	4.00	10 p. c. off bills over $10; 5 p. c. off bills under $10.
Brockville, Ontario.	3.75	
Bloomfield, N J.	3.75	
Belleville, Ill.	3.50	
Bellaire. Ohio	2.85	5 p ct. off prompt pay.
Barnesville, Ohio.	3.00	5 p ct. off prompt pay. Street lamps $17.50 per ann. Burn till 12 P. M. on moonless nights.
Boston, Mass.	2.25	
Bath, Maine	4.00	12½ p c off prompt pay.
Bayonne City, N. J.	4.00	Net.
Binghampton, N. Y.	4.00	10 p c off prompt pay on bills for 1000 per month.
Buffalo G L Co., N Y.	2.50	10 p c off prompt pay.
Buffalo Mutual, N Y.	2.50	10 p c off prompt pay.
Buffalo Citizens, N Y.	2.50	10 p c off prompt pay.
Bloomsburg, Pa.	10.00	70 candle gas, 10 p c off prompt pay. Patton's process.
Burlington, Iowa	3.75	15 p c off bills of $100, and 2c p c over $200. Street lamps $25.22 each, per annum.
Cleveland, Peoples, O	2.00	
Cumberland, Md.	3.00	
Charleston, W. Va.	4.00	25 p. ct. off prompt pay Meter rent 25, 30, and 50 cents. per m. for 3, 5 and 10 light.
Cincinnati, Ohio	2.25	
Columbia, Mo.	4.50	
Carondolet, South St. Louis, Mo.	3.00	5 p. ct. off prompt pay,
Chattanooga, Tenn.	3.00	
Cold Water, Mich.	3.25	
Chicago, Ill.	2.50	
Columbia, Pa.	2.85	Lowe process.
Charlottesville, Va.	2.50	Meter rent 20 cents.
Cedar Rapids, Iowa.	4.50	50 cts p M. off prompt pay.
Cairo, Ill.	3.75	50 cts added if not paid by the 5th.
Cortland, N. Y.	4.00	25 cts p M. off prompt pay.
Cairo, Ill	3.75	50 cents per month off prompt pay. For 20,000 feet a month $2.50.
Chillicothe, Ohio.	3.00	
Camden, N. J.	3.16	5 p c off prompt pay; 10 p c off for 100,000 per year.
Carson City, Nevada	8 00	Gas from wood and Cannel coal.
Cadiz, Ohio	3.50	10 p c off on 500 feet or less; 50 cts per M. on from 500 to 2000; 20 p c off on 2000 and upwards.
Derby, Conn.	3.60	10 p. c. off prompt pay, and 50 cts per M. on excess of 5000 ft. per month.
Decatur, Ill.	3.50	50 cts. per M. added, if not paid by 10th.
Danbury, Conn.	4.28	For less than 5000 per month.
" "	3.85	For over 5000 per m th
Dover, Del.	3.60	
Dunkirk, N Y.	2.50	Street lamps till 12, moonless nights $25 per annum.
Defiance, Ohio.	10.00	70 candle gas, 20 p c off prompt pay. Patton's process.
Delaware, Ohio.	3.00	No charge for meter.
East Boston, Mass.	3.00	
East St. Louis, Ill.	3.50	5 p. c. off prompt pay.
Evansville, Ind.	3.00	City lamps $30.
Erie, Pa.	3.00	City lamps $28 p. an.
Elkhart, Ind.	3.50	
East Newark, N. J.	4 00	
Eastchester, N. Y.	3.50	
Elizabethtown, N. J.	3.00	
East N Y (Union) L I.	3.00	
Eastport, Me.	4.00	
Fredericksburg, Va.	3.40	
Flint, Mich.	3.50	
Franklin, Pa.	3.00	
Fall River, Mass.	3.00	
Freeport, Ill.	3.80	
Fort Scott, Kansas.	4.50	
Flatbush, L. I.	3.50	
Fredonia, N. Y.	3.00	Street lamps $25 per annum; burn fill 12 P. M.
Guelph, Ontario.	3,50	
Geneva, N, Y.	2.50	5 p. c. off prompt pay. Wood and oil gas.
Greensboro, N. C.	4.00	
Galena, Ill.	4.50	Meter rent 25 cts. per month.
" "	4.00	After September 1st.
Grand Rapiids, Mch.	2.80	For less than 1000 feet per month.
" " "	2.50	For over 1000 eet per month. 10 per ct discount on 300,000 ft annually
Gloucester, N. J.	3.15	5 p c off prompt pay.
Greenwich, Conn.	2.40	Wren's process
Goshen, Ind.	10.00	70 candle gas, 20 p c off prompt pay. Patton's process.
Huntsville, Ala.	3.50	
Hempstead, L. I.	4.00	
Huntingdon, Pa.	3.80	10 per ct. off prompt pay.
Hagerstown, Md.	3.75	
Hamilton, Ohio.	4.00	
Hillsdale, Mich.	3.50	
Holyoke, Mass.	3.01	
Hartford, Conn.	2.75	
Hornellsville, N. Y.	3.50	50 cents per 1000 off prompt pay.
Honesdal e, Pa.	4.00	12½ cents meter rent per month.
Hannibal, Mo.	3.00	No meter rent.
Ithaca, N. Y.	4.00	5 p. c. off prompt pay.
Indianapolis, Ind.	2.50	
Indiana, Pa.	3.00	10 p. c. off prom pay Meter rent 50 cents per month.
Jersey City, N. J.	2.75	
Joliet, Ill.	3.50	
Jacksonville, Ill.	4.00	12½ p.c. off prompt pay.
Jefferson City, New Orleans, La.	4.00	
Johnstown, N Y.	3.50	
Knoxville, Tenn.	3.00	Meter rent 15 cents.
Lyons, N. Y.	4.00	
Lima, Ohio.	3.80	
Lynchburgh, Va.	3.00	5 p. ct. added to bills not paid in 5 days.
Louisiana, Mo.	4.50	
La Crosse, Wis.	4.50	50 cents per M. off prompt pay.
Lancaster, Pa.	3.00	
Louisville, Ky.	2.70	5 p. c. off prompt pay.
La Porte, Ind.	3.50	Wood and oil gas.
Lowell, Mass.	2.50	25 cents per 1000 off prompt pay.
Lafayette, Ind.	2.75	
Lexington, Mass.	2-40	Wren's process.
Los Angelos, Cal.	6.00	
Lockport, N Y.	3.20	Less 20 p c per M. if paid within 30 days.
Millville, N. J.	3.12	
Milford, Del.	3-50	
Marquette, Mich.	3.50	
Morris, Ill.	2.00	For 15 candle power, or $10 per M. coal gas meter measure (Petroleum Gas—Wren's patent).
Meriden, Conn.	3.93	
Marietta, Ohio.	3.50	20 cts. per M. off if paid by 6th. Consumers over 3000 ft. 30 cts. additional discount.
Marshalltown, Iowa.	4.50	50 cts p M. off prompt pay.
Meadville, Pa.	3.50	25 cts p M. off prompt pay.
" "	2.50	For over 10,000 ft. per month,
Madison, Ind.	3.75	25 p c off if paid in five days: 25 to 40 cents per month meter rent.
Monroe, Mich.	3.50	5 per ct off prompt pay
Malone, N. Y.	4.50	
Middletown, Conn.	3.56	Net.
Mount Sterling, Ky.	4.50	
Monongahela, Pa.	2.75	Under 5000 feet m'th $2.75 per M.; over 5000 feet per month $2.50 per M.
Minneapolis, Minn.	5.00	10 p c off prompt pay.
Mahanoy City, Pa.	10.00	70 candle; 20 p c off prompt pay. Patton's process
Morristown, Pa.	3.00	18 candle coal, an
New York, New York.	2.50	
" " Harlem.	2.75	
" " Manhattan	2.50	
" " Mutual.	2.50	
" " Mropolitan	2.50	
" " Municipal.	2.50	Water Gas.
Nashville, Tenn.	2.85	
Newark, Citizens, N.J.	2.85	
Norfolk, Va.	3.10	
New Brunswick, N. J.	2.70	
Newton, N. J.	4.00	
North Attleboro, Mass.	3.50	
New Britain, Conn.	3.70	
New Haven, Conn.	2.75	
Nantucket, Mass.	3.00	Meter rent 15 cts. p. m.
Newark, N. J.	2.85	
Niagara Falls, N. Y.	3.50	20 cts p M. off prompt pay.
Norwalk, Conn.	4.00	12½ p ct off prompt pay.
New Albany, Ind.	3.00	
New City, Montreal.	2.50	Street lamps, $22 p an
Oswego N. Y.	3.15	5 p. c. off prompt pay.
Ottawa,, Ill.	4.00	12½ p. c. off promptpay
Omaha, Nebraska	5.00	
P'keepsie, Citizens.	2.70	Gwynne Harris process
Paterson, N. J.	3.80	10 p c. off prompt pay, and in addition 5 p.c. on bills of $200; 10 p. c. on bills of $1000
Portchester, N. Y.	3.50	
Pittsfield, Mass.	3.50	5 p. c. off prompt pay, and 10 p. c. off on bills of $350 per an
Portland, Me.	3.00	
Paris, Ky.	4.50	Meter rent 25 cts. p m.
Portsmouth, N. H.	3.22	
Pittsburgh, Pa.	1.00	
Philadelphia, Pa.	2.15	
Painesville, Ohio	3.50	
Pawtucket, R. I.	2.80	5 p c allowed on bills of $500, and 10 p c on bills of $1500 for six months.
Providence, R. I.	2.25	
Pottsville, Pa.	3.50	10 p ct off promp pa
Plainfield, N. J.	3.50	5 p ct off for less tha 5000 a month. 10 per cent more than 5000 a month.
Peoria, Ill.	3.50	
Paducah, Ky.	4.00	10 p c off prompt pay.
Plymouth, Pa.	10.00	70 candle. Patton's process.
Pottstown, Pa.	3.20	Public lamps till 11 P. M., 18 nights per month $20 per lamp.
Poughkeepsie, N Y.	2.60	10 p c off prompt pay.
Port Huron, Mich.	3.50	
Quincy, Citizens, Mass.	5.00	
Quincy, Ill.	3.50	
Quebec, Ont.	2.40	
Rome, N. Y.	3.60	
Rochester, N. Y.	3.00	
" Citixens.	3.00	
Rondout, N Y.	3.60	

Rockford, Ill.	4.00	5 p c off prompt pay; 10 to 25 p c off on bills for 500 to 25 M, feet per month.
Richmond, Ind.	3.00	50 cents added if not paid by 20th.
Syracuse, N. Y.	2.75	
Springfield, Ill.	3.25	$25 for city lamps.
St. Joseph, Mo.	4.00	12½ p. ct. off on bills over $100 p. month.
St. Albans, Vt.	5.00	10 p. c. off prompt pay, and in addition 5 p. c. off bills from $50 to $100 per month; 10 per. ct. off bills over $100.
Sandusky, Ohio.	3.00	
Saratoga, N. Y.	5.00	20 p. c. off prompt pay, Nov. 1st to May 1st. 10 p. c. rest of year.
San Antonio, Texas.	7.00	10 per ct off from 10 to 20,000 per month 20 p ct off from 20,000 and upwards.
St. Charles, Mo.	4.50	
Sidney, Ohio	3.25	
Steubenville, Ohio	2.50	
Sherman, Texas	5.00	5, 10, 15 and 20 p. c. off, according to quantity.
Salem, Oregon	7.00	October last reduced from $8.
Salem, Ohio	2.75	Meter rent 12½ cts if 300 feet is not used monthly
Sedalia, Mo.	3.50	
Sharon, Pa.	3.15	5 per ct off on less than 5000 feet per month. 10 p ct from 5 to 15 M. 15 p ct from 15 to 20 M. 20 per ct over 40 M.
Shreveport, La.	5.00	
Shelbyville, Ind.	2.00	Wren's process; $10 for 80 candle gas.
Shenandoah, Pa.	10·00	70 candle. Patton's process.
Shamokin. Pa.	10.00	70 candle. Patton s process.
Sunbury, Pa.	10.00	70 candle. Patton's process.
Tiffin, Ohio.	3.00	
Titusville, Pa.	3.00	
Tidioute, Pa.	2.00	Wren's process.
Vicksburgh, Miss.	4.50	
Wilkesbarre, Pa.	3 50	10 p. c. off prompt pay.
Worcester, Mass.	3.00	5 p. c. off on $500, and 10 p. c. off on $1000 in six months.
Westfield, N. Y.	4.00	10 p. c. off prompt pay.
Washington, D. C.	2.25	
Watertown, N. Y.	4.50	10 p. c. off prompt pay.
Wheeling, West Va.	2.25	10 p ct off prompt pay.
Washington, Pa.	2.50	
Woburn, Mass.	3.00	
Waterbury, Conn.	3.50	5 p c off on biils of $50 10 p c off on bills of $100. 5 p c added if not paid by 10th.
York, Pa.	3.00	Meter rent 12½ cents.
Youngstown, Ohio.	2.50	10 p. c. off on bills of $50 per month.
Waterbury, Conn.	3.00	5 p c off on bills of $50, 10 p c off on bills of $100; 10 p c added if not paid by 10th.
Washington, C H., O.	1.20	Wren's process; $6 for 80 candle gas.
Wilmington, Del.	2.50	Street lamps 3,650 hrs per year, $31.50 per lamp.
Zanesville, Ohio.	2.70	10 p. c. off on bills of $25 per month; city lamps $23.

Gas Stocks.

Quotations by W. B. Scott & Co., Bankers,

24 Pine Street, New York City.

July 3, 1876.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked.*
Harlem	$1,850,000	50	120	122
Manhattan	4,000,000	50	235	240
Metropolitan	2,500,000	100	145	150
" Scrip	$1,000,000	..	102	—
" Bonds	500,000	1000	104	—
Mutual	5,000,000	100	115	—
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	130	135
Central, Westchester	466,000	50	100	105

Gas Co.'s of Brooklyn.

Brooklyn	2,000,000	25	190	195
Citizens	1,200,000	20	85	87
" Scrip	320,000	1000	95	100
Peoples	1,000,000	10	50	55
" Bonds	$ 325,000	...	—	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	70	78
Nassau	1,000,000	25	75	80
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	125	130
" Scrip		...	100	103

Out of Town Gas Companies.

Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	—	90
Baltimore, Md.	2,000,000	100	150	170
" Ctfs., gold	1,000,000		105	—
Bayonne, N. J.		100		90
Brockport, N. Y.	25,000	100	...	80
Citizens, Newark.	918,000	50	87½	—
" " Ctfs.	53,000	—	—	—
" " Bds.	124,000	—	—	—
Derby of Conn.	160,000	100	60	80
East Boston, Mass.		25	132	—
Fort Wayne, Ind		100	...	—
Hannibal, Mo.	100,000	100	95	100
Hartford, Conn.	700,000	25	152	—
Hempstead, L	25,000	100	...	—
Jersey City	386,000	20	160	—
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill.	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohio	60,000	100	10	...
" Bonds	30,000		90	
Laclede, St Louis Mo	1,200,000	100	—	100
Peoples, Jersey City		...	125	135
Peoples of Albany	650,000	100	—	20
" Bonds	350,000	1000	—	—
Peoples of Baltimore		25	99	100
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y.		100	50	60
Richmond Co., S. I.	300,000	...	100	105
Woonsocket, R. I.	150,000	100	100	...
Halifax N. S.	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas-Co., S. Fr'isco Cal.			99	100
St. Louis, Missouri.	600,000	50	—	100
Stillwater, Minn.	50,000	50	—	26
Suburban, W'stch'str	390,000	50	—	100
Saugerties, N. Y.	15,000	100	110	115
Troy, Citizens	600,000	100	—	100

The Williamsburgh Gas Company have declared their regular quarterly dividend of 3%, payable on demand. The interest on the scrip of the same company was paid the 24th inst.

The Metropolitan Gas Company of New York City have declared a dividend of 5%, payable August 1st, and 3½ on scrip, payable same date.

The Citizens Gas Company of Brooklyn passed their regular dividend July 1st.

PRICES OF FOREIGN AND DOMESTIC GAS COALS.

[Reported Expressly for this Journal.]

July 17, 1876.

DELIVERED IN NEW YORK.

English Cannel.

Ince Hall	$17 00	@	18 00
Kirkless Hall	16 50	@	17 00

English Caking Coals.

Newcastle Gas	$5 50	@	00 00
Liverpool caking	11 50	@	12 00

British Province Coals.

Pictou			2 00
Block House—At Mines, $1.87, Gold			2 00
Caledonia—At Mines, $1.50, Gold			0 00
Little Glace Bay—At Mines, $1.75, Gold			0 00
Lingan—At Mines, $1.75, Gold			0 00
Sydney—Old Mine			3 00
" Reserve, $1.75, GoldMine			0 00
" International			— —

Duty, 75 cents per ton, gold. Freight to New York $2 00 currency. Cost of above coals delivered in New York, $4 75 @ $5 00, currency.)

Pennsylvania Coals.

Penn Gas Coal—At Amooy	$5 60	@	0 00
Westmoreland—At Amboy	5 60	@	0 00
Shafton	5 60	@	0 00

(In New York, the above coals $6 00)

Youghiogheny	6 00	@	0 00
Waverly	6 00	@	0 00

West Virginia Coals.

MurphyRun	6 50	@	0 00
Despard	6 50	@	0 00
West Fairmont	6 50	@	0 00
American Gas Coal	7 40	@	0 00
Fairmont	6 50	@	0 00
Newburgh Orrel	6 50	@	0 00
Pinnickinick	6 50	@	0 00
Cloverhill of Virginia	6 00	@	6 50
McKenzie Compound Mixture			— —

American Cannel Coals.

Peytona of West Virginia	$12 50	@	00 00
Darlington of Pennsylvania			— —
Cannelton Cannel			11 00
Red Bank—at Philadelphia			6 50
" —at South Amboy			7 25

Asphalts.

Albertite of New Brunswick	$21 00	@	— 00
Trinidad Bitumen	— —	@	14 00

The Penn Gas Coal Company have contracted with the Pittsburgh Gas-Light Co. for their entire supply for the ensuing year from their Youghiogheny mines.

Within the last week contracts have been made by some of the companies in New York for about 200,000 tons of Penn Westmoreland, Waverly, Youghiogheny, and the West Virginia caking coals—at $6·00 per ton a reduction of 50 cents from last years' prices.

WHEELER & WINTERTEEN,

INSPECTORS OF

Gas Meters aud Repairers.

Gas Companies having Meters to be repaired will please inform us. The best references given from different Gas Companies and State Inspectors. Address for terms, office 1513 Fourteenth St., Washington, D. C. 411-6m

NATIONAL FOUNDRY

AND PIPE WORKS.

OFFICE AND WORKS—CARROLL, PIKE, SMALLMAN AND WILKINS STREETS,

PITTSBURGH, PA

WM. SMITH,

Manufacturer of all kinds of GAS and WATER PIPE BRANCHES, CONNECTIONS, T's, ELBOWS, an all CASTINGS USED AT GAS AND WATER WORKS,

We offer special inducements to parties wishing to purchase. My Pipe is Smooth, regular in weights, and cast vertically.

N. B.—Pipe from 3 inch and upwards, cast in 12-ft. lengths.

☞ SEND FOR CIRCULAR AND PRICE LIST. ☜

JAMES MARSHALL & CO.

Franklin Foundry and Pipe Works,

MANUFACTURERS OF

GAS, WATER, AND OIL PIPES,

Works, 18th, 19th, 20th and Railroad Street. Office, No. 23 Nineteenth Street.

Pittsburgh, Pa.

Pipes from 3-inch and upwards cast in 12 ft. lengths.

☞ Send for Circular and Price List

NOTICE TO GAS COMPANIES.

WANTED—A SITUATION BY A YOUNG MAN, who has had upwards of Nine Years experience in Repairing and Fixing Gas Meters. Has had some experience in Gas Fitting, etc.; willing to make himself generally useful. Good references given. Address to C. McKAY, 342 Milwaukee street, Milwaukee, Wisconsin. 409-3t

FOR SALE,

A HALF INTEREST IN A SMALL GAS WORKS WILL be sold, or leased to a practical gas man. Two thousand feet of natural gas per day. Address

J. SHACKELTON,
Westfield, N. Y.

405-tf

S. DECATUR SMITH,

CAST IRON GAS and WATER PIPE,

Foundry, Cor. of York and Moyer Streets,

PHILADELPHIA.

Several Thousand 2, 3, 4, 6 and 8 Inch Cast Iron *Gas and Water Pipes* on hand, for immediate delivery.

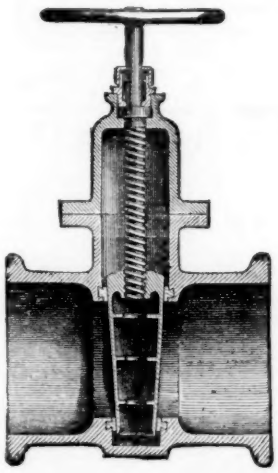
☞ FITTINGS FOR GAS AND WATER MAINS. ☜

CHAPMAN VALVE MANUFACTURING CO.

MANUFACTURERS OF

CHAPMAN GAS VALVES.

Office and Sales Room 75 and 77 Kilby Street, Boston.



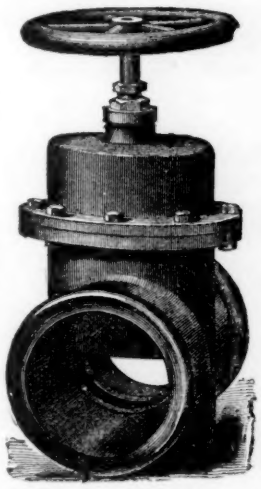
These Valves have been in use for several years, and are pronounced by all who have used them to be

The Best Gas Valves Ever Made.

They afford a direct passage the full size of the pipe. The seats are made of an alloy similar to BABBITT metal, specially prepared for the purpose, and superior to all other metals used for the seats of Gas Valves. It does not corrode under any circumstances to which it is exposed.

There is NO LIABILITY OF COHESION between the Gate and Seat, and the Valves can be relied upon to SHUT TIGHT and OPEN EASILY at all times—an important desideratum when used for street mains, in cases of fire.

We refer to the following named Gas-Light Companies among the many that have used these Valves:



BOSTON GAS-LIGHT COMPANY, BOSTON, MASS.
CAMBRIDGE GAS-LIGHT COMPANY, CAMBRIDGE, MASS.
NEWTON & WATERTOWN GAS-LIGHT CO., WATERTOWN, MASS.
LAWRENCE GAS-LIGHT COMPANY, LAWRENCE, MASS.
PEOPLES GAS-LIGHT COMPANY, BROOKLYN, N. Y.
CITIZENS GAS-LIGHT COMPANY, BROOKLYN, N. Y.
SOUTH BOSTON GAS-LIGHT COMPANY, BOSTON, MASS.
CHARLESTOWN GAS-LIGHT CO., CHARLESTOWN, MASS.
LYNN GAS-LIGHT COMPANY, LYNN, MASS.
FITCHBURG GAS-LIGHT COMPANY, FITCHBURG, MASS.
CITIZENS GAS-LIGHT COMPANY, NEWARK, N. J.
WILLIAMSBURGH GAS-LIGHT CO., WIRLIAMSBURGH, N. Y.

GAS AND WATER VALVES ½ INCH TO 36 INCHES DIAMETER. STEAM VALVES ½ INCH TO 12 INCHES DIAMETER.

B57-tf

Advertisers Index.

GAS BURNERS, APPARATUS, ETC.

American Meter Co.—West 22nd st., N. Y., Arch and 22d st., Phil., 548 Washington st., Boston.
Cast Iron Gas and Water Pipe—S. Decatur Smith, York and Moyer streets, Phila., Pa.
Cast Iron Gas and Water Pipes—R. D. Wood & Co., Philadelphia Pa.
Cast Iron Gas and Water Pipe—McNeal & Archer, Burlington, N. J.
Clay Gas Retorts, etc.—Gardner Bros., 96½ Fourth Avenue, Pittsburgh, Pa.
Cast-Iron Pipes and Fittings—B. S. Benson, 52 East Monument street, Baltimore, Md.
Cast Iron Pipes for Water and Gas—Riley A. Brick, 112 Leonard street, N. Y.
Cast Iron Gas and Water Pipe, etc.—H. R. Smith & Co., Columbus, Ohio.
Gas Valves (Chapman) 75 and 77 Kilby st., Boston, Mass.
Gas-Burners—C. Gefrorer, 248 North 9th st., Phila., Pa.
Gas Purification—St. John and Cartwright, 21st and Avenue A, New York.
Gas Meters, etc.—Harris, Griffin & Co., 12th and Brown streets, Phila., Pa.
Gas Meters, etc.—Wm. W. Goodwin & Company, 1012 Filbert street, Phila, Pa.
as Meter Manufacturers—Harris, Heime & McIlhenny, 1117 Cherry st., Philadelphia, Pa
Gas Fixtures, Etc.—Mitchell, Vance & Co., 597 Broadway
Gasholders, Etc.—Deily & Fowler, 39 Laurel st., Phila., Pa.
Gas-Light Company of America, 63 and 64 Drexel Building, New York.
Gasholders—George Stacey & Co., Ramsay st., Cincinnati, O.
Lava Tips and Scotch Tips—Charles H. Meyer & Co., 227 Chestnut street, Phil. Pa.
Patent Conically Slotted Wood Trays—John L. Cheesman, 147 and 149 Avenue C., N. Y.
Patent Gas Exhauster—Smith & Sayre, 95 Liberty stireet.
Pelouze & Audouin Condenser—Jas. R. Smedberg, Sole Agent for U. S. San Francisco, Cal.; Henry Cartwright, 2107 Green street, Phil. Pa.
Patent Gas Exhauster—S. S. Townsend, Agt., 31 Liberty street, N. Y.

GAS COALS

Cannelton Coal Co. of West Virginia—J. Tatnall Lea 325 Chestnut street, Phila, Pa.
Cannel Chips—H. E. Hoy, 34 New street, N. Y.
Despard Coal Co.—Parmelee & Bros. Agents 32 Pine st. New York.
Gas Coals—Perkins & Job, 27 South st., N. Y.
New York and Cleveland Gas Coal Company—384 Penn Avenue. Pittsburgh, Pa.
National Coal Gas Company—H. P. Allen, 4 Warren st., N.Y.
Penn Gas Coal Co.—11 Merchants' Exchange, Phil. and 90 Wall street, N. Y.
Peytona Cannel Coal—S. E. Low, 58 Broadway, N. Y.
Tyrconnell Gas Coal—52 S. Gay Street, Baltimore, Md.
Youghegheny Coal—Perkins & Job, 27 South St. N. Y.
Scotch Cannel Coals—James McKenzie, Cannel Coal Merchant, Haymarket, Edinburgh.

FOUNDRIES.

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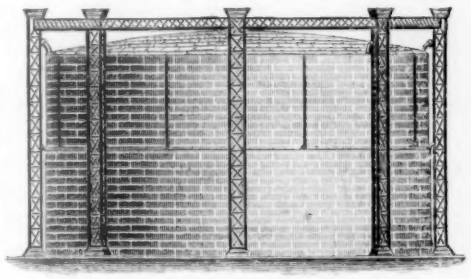

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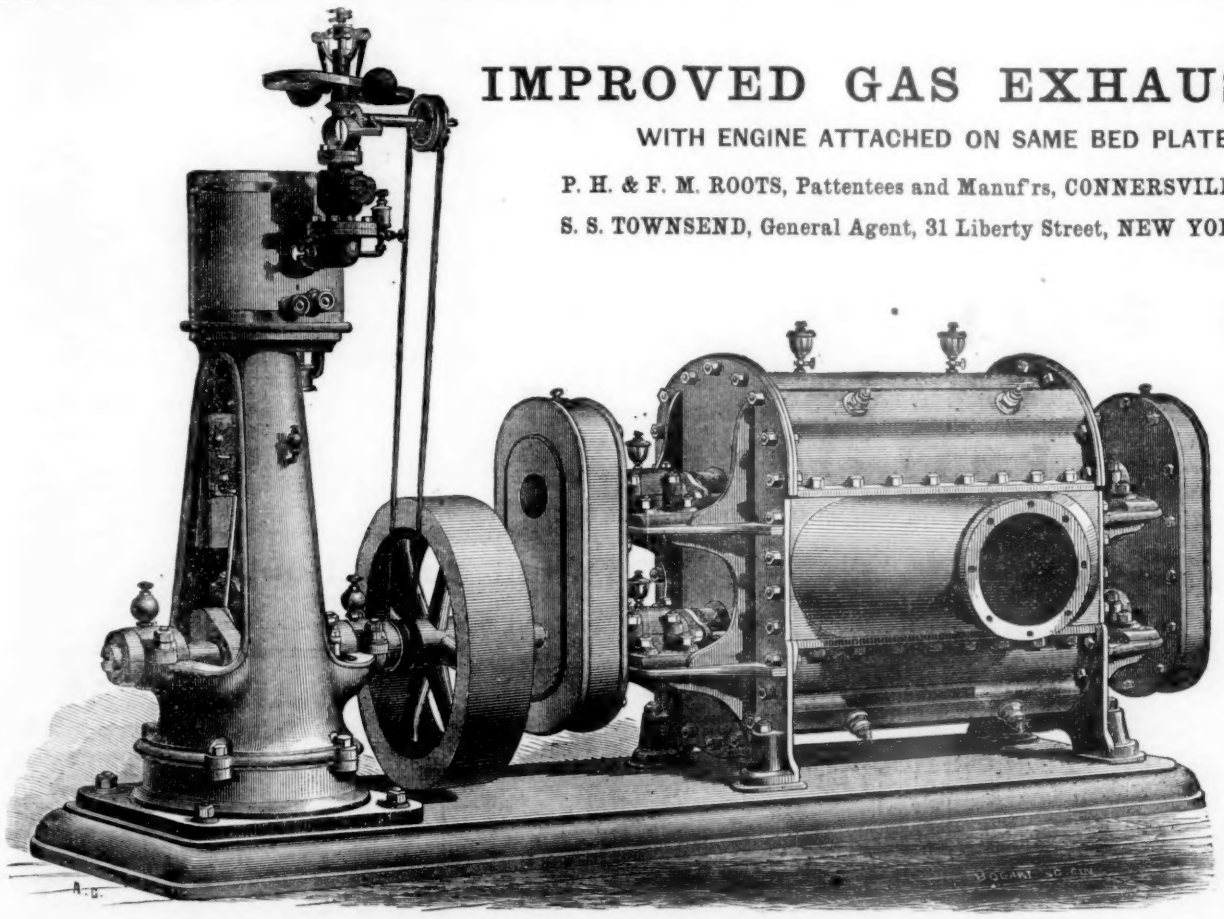

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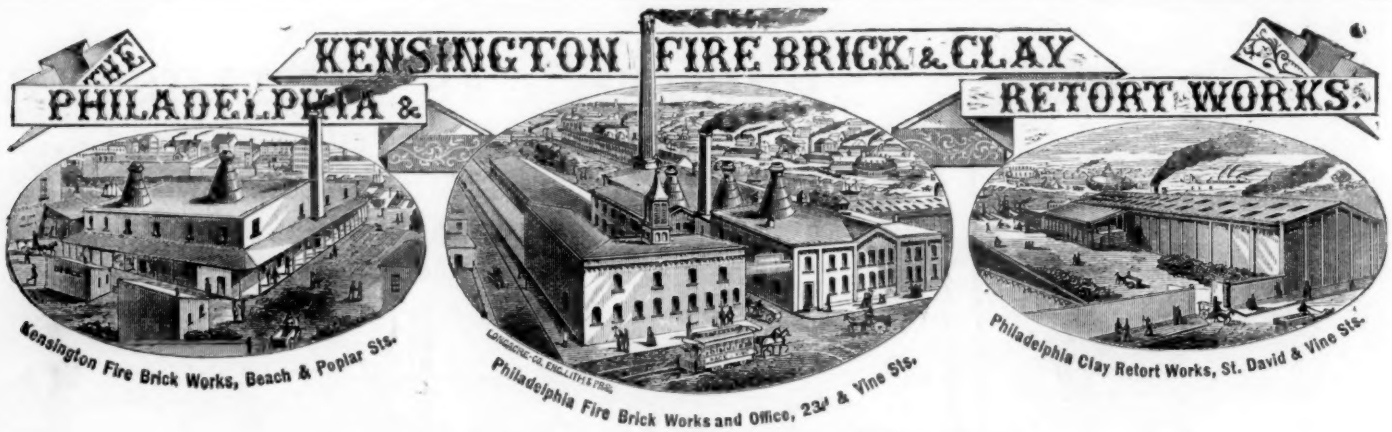
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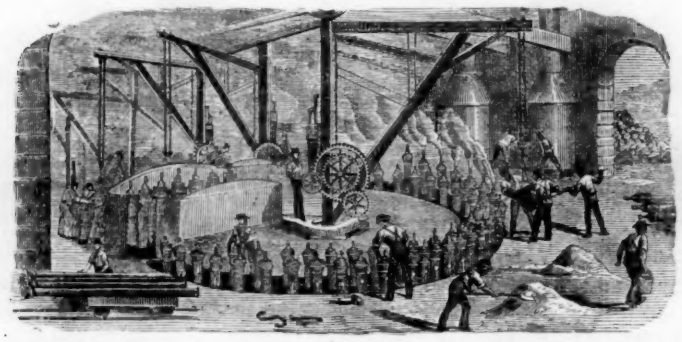

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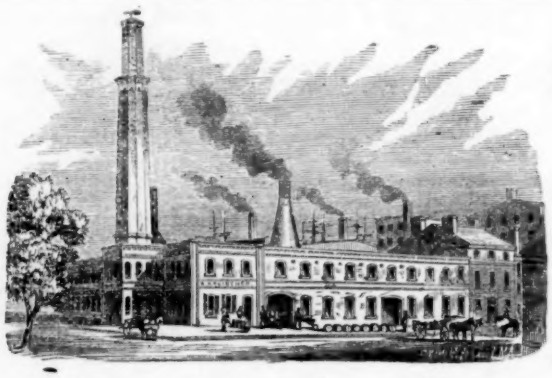

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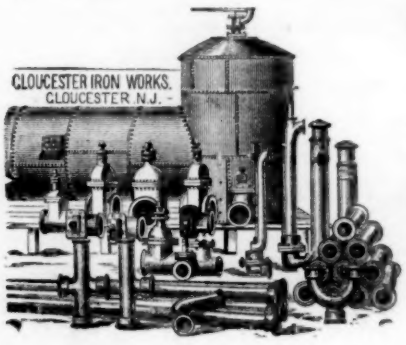

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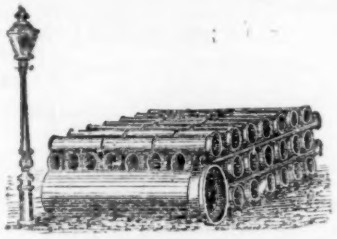

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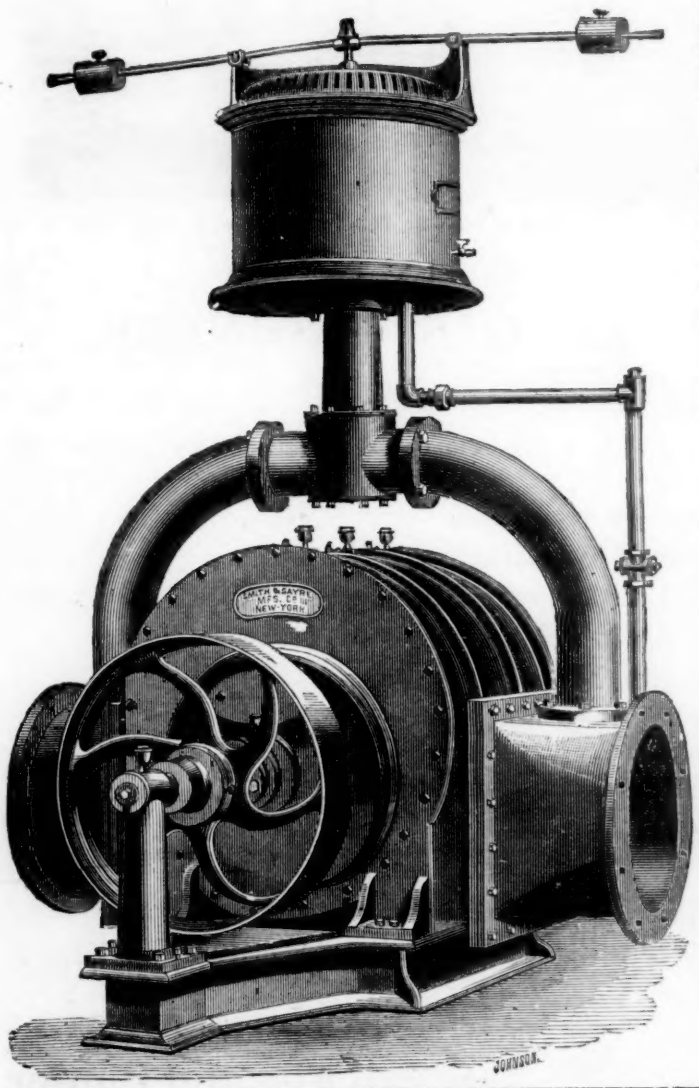

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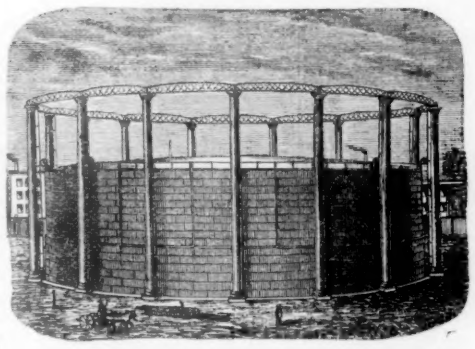

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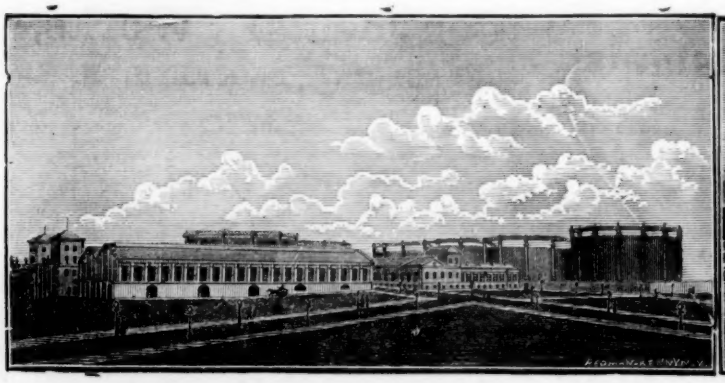

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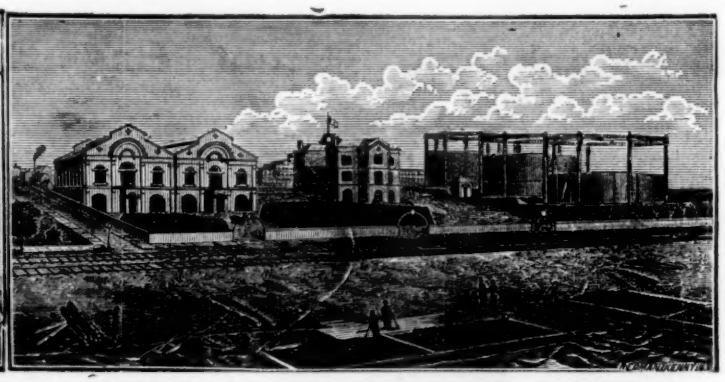

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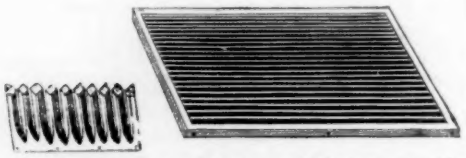

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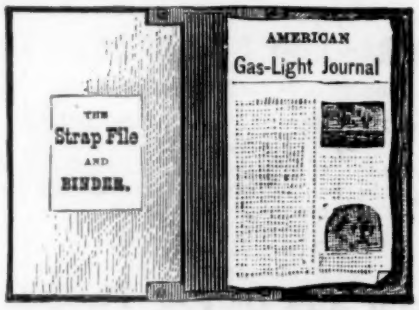

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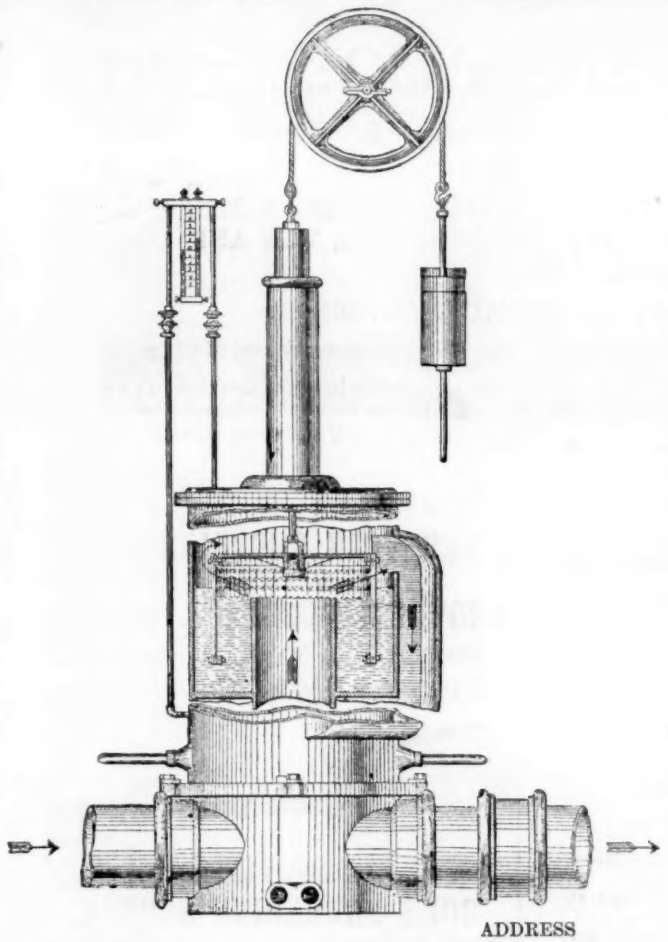

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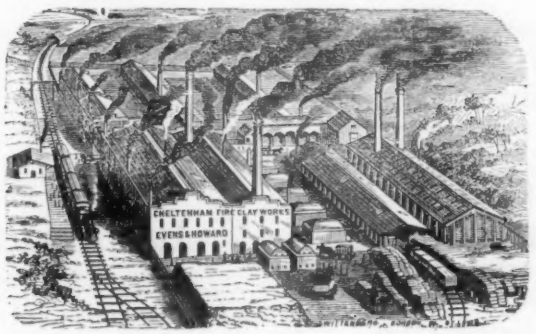

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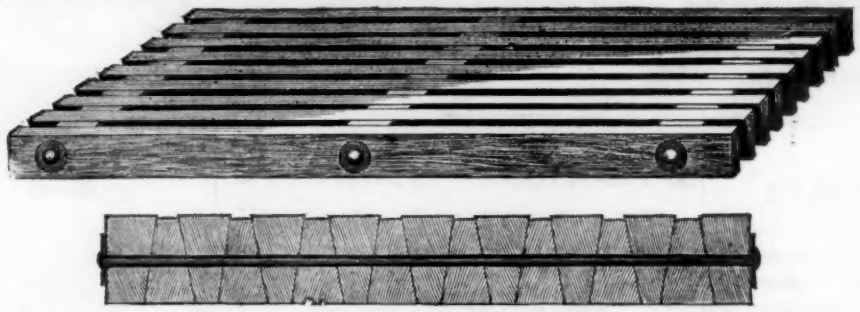

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St. Paul Gas-Light Company, Minn.
Cumberland Gas-Light Company, Md.
Hartford City Gas-Light Company, Conn.
Richmond Gas Company, Va.
McKeesport Gas Company, Pa.
Middletown Gas Company, Pa.
East Newark Gas-Light Company, N. J.
Binghampton Gas Company, N. J.
Zanesville Gas Company, Ohio.
New Orleans Gas Company, La.
Salem Gas-Light Company, Mass.
New Britain Gas-Light Company, Conn.
Rahway Gas-Light Company, N. J.
Trenton Gas-Light Company, N. J.
Elmira Gas Company, New York.
Erie Gas Company, Pa.
Columbus Gas-Light Company, Ohio,
Westchester Gas-Light Company, N. Y.
Santa Cruz Gas Company, Cal.
Lawrence Gas-Light Company, Kansas
Salem Gas Company, N. J.
Indiana Gas-Light Company, Pa.
Peoria Gas Company, Ill.
Moniclair Gas Company, N. J.
Williamsport Gas Company, Pa.
Wooster Gas-Light Company, Ohio.
Augusta Gas-Light Company, Ga.
Huntsville Gas Company, Ga.
Chattanooga Gas Company Tenn.
Murfreesboro Gas Company, Tenn.
Hagerstown Gas-Light Company, Md
Hanover Gas Company, Pa.
Easton Gas Company, Pa.
Uniontown Gas-Light Company, Pa.
Coatesville Gas-Light Company, Pa.
Houston, Gas Company, Texas.
Wilkesbarre Gas Company, La.
Middletown Gas Company, New York
Washington Gas-Light Company, Pa.
Princeton Gas-Light Company, N. J.
Newark Gas Company, Ohio.
Pontiac Gas-Light Company, Mich.
And numerous other Companies.